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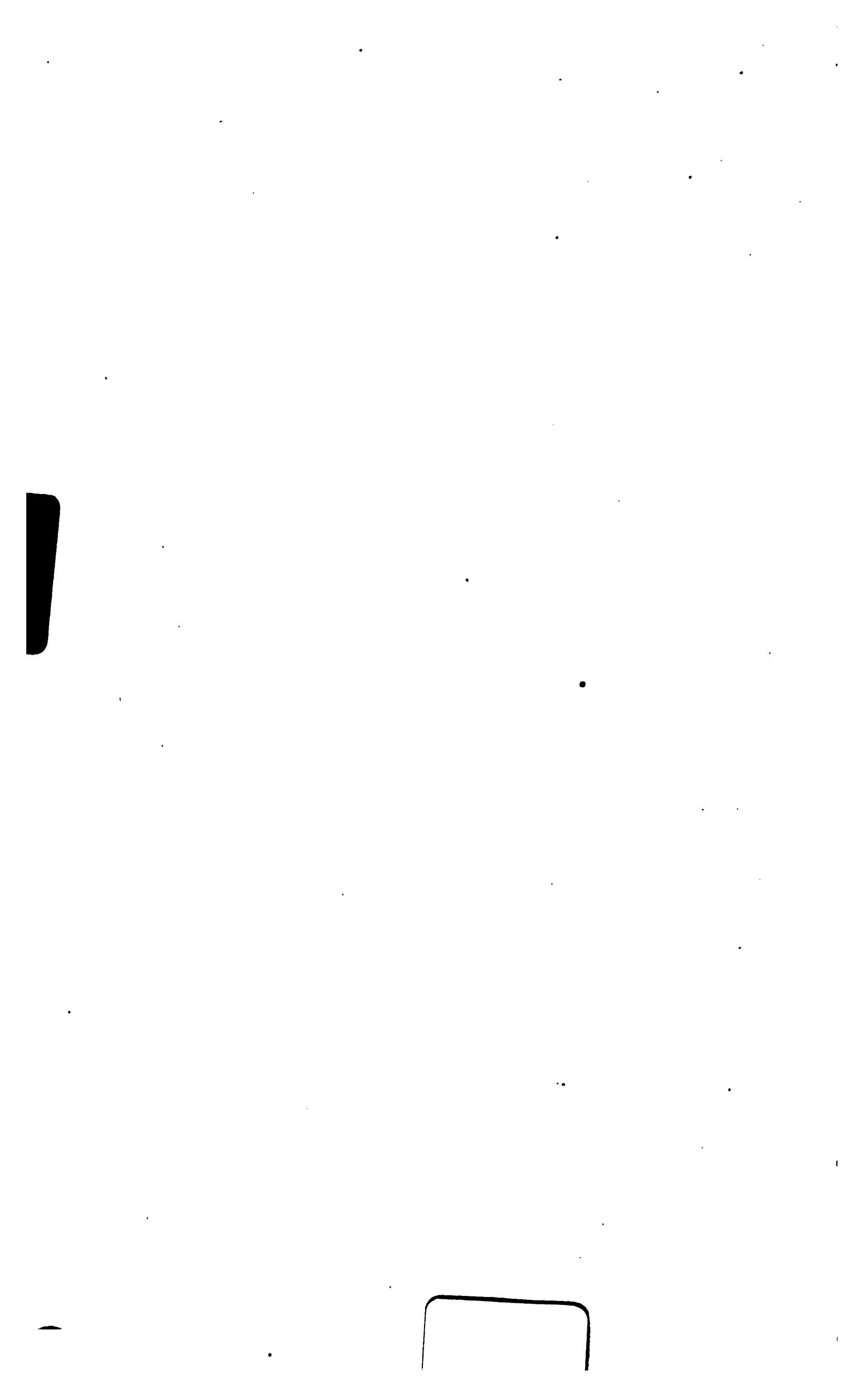
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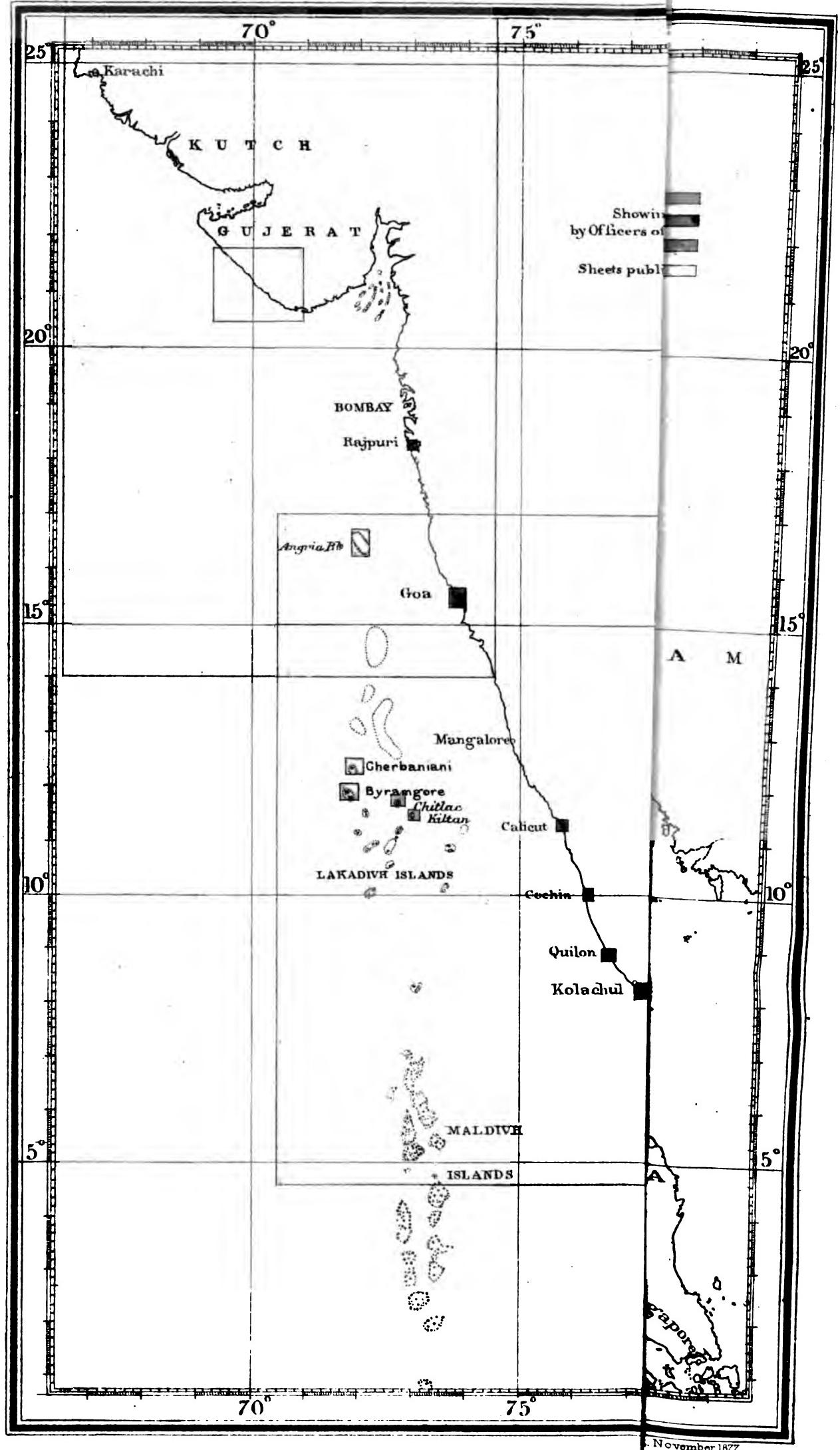
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GENERAL REPORT

ON THE OPERATIONS OF

The Marine Survey of India,

FOR THE YEAR

1876-77.

PREPARED FOR SUBMISSION TO THE GOVERNMENT OF INDIA

BY

COMMANDER A. DUNDAS TAYLOR, (LATE I. N.) F.R.G.S.,

SUPERINTENDENT OF MARINE SURVEYS.



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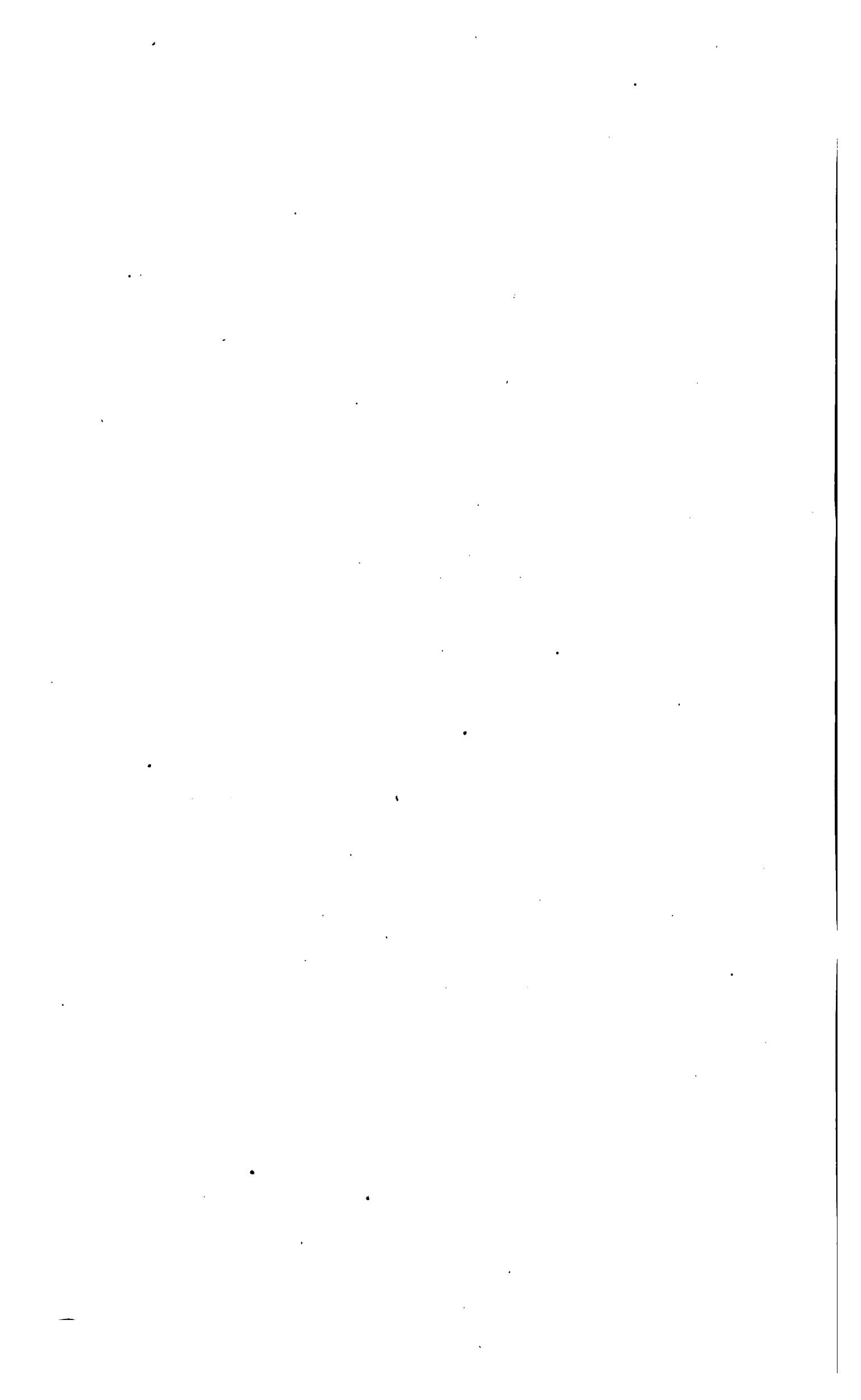
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GENERAL REPORT
ON THE OPERATIONS OF
The Marine Survey of India,
FOR THE YEAR
1876-77.

Dated Calcutta, the 1st January 1878.

SECTION I.

GENERAL REPORT.

I HAVE the honour to submit, for the information of the Government of India, my annual report of the proceedings of this Department throughout the year, giving details of the actual surveys executed, and the outturn of work in the Drawing Branch and Office.

2. The following is a summary of the surveying operations of the year under review, given in the order in which they will be found described in this report :—

- (a) Madras Roadstead.
- (b) Entrance of Chittagong River.
- (c) Approaches to the Moulmein (Salween) River.
- (d) Corrected position of Double Island light on Admiralty sheet No. 823—Coronge Island to White Point.
- (e) A meridian distance between Amherst Pagoda and Diamond Island, Cape Negrais.
- (f) Main triangulation and portion of coast of Akyab.
- (g) Additions and corrections, Kyuk Phyou Harbour.
- (h) Additional soundings on Admiralty Charts.

3. In March 1876 I pointed out to Government the necessity of my visiting Tavoy, Mergui, and Pakchan on the coast of Burma, for the purpose of testing existing charts and correcting any errors, which desultory operations a short visit might enable me to carry out. My attention had more especially been directed to this part of the coast, from the fact that the British India Steam Navigation Company's steamer *Moulmein* had struck on a rocky shoal in Tavoy River during September 1875, and that in February 1876 the steamer *Mahratta* struck on another rock in the same river and narrowly escaped being wrecked; whilst neither of these rocks was marked on the charts.

4. On the 4th April, with the sanction of the Government of India, communicated in letter No. 260 (Surveys), dated the 23rd March 1876, I embarked on board the Tour of inspection to Burma Ports. British India Steam Navigation Company's steamer *Busheer* on a tour of inspection of the principal ports on the coast of Burma. I visited Akyab, Bassein, Rangoon, Moulmein, Tavoy, Mergui and Pakchan River; also the ultra-Indian ports of Kopah and Junkseylon on the Siam Coast; and I was carried onward to Penang, there being no other way of returning except by the same steamer. I left the latter

place on 2nd May, re-visiting all the above ports *en route*, and reached Calcutta by the 25th May.

5. From this inspection, after examining the chart of Amherst, which was found most incorrect and incomplete, I came to the conclusion that no large port of British India so much required to be carefully surveyed. Accordingly Navigating Lieutenant Jarrad was despatched

Admiralty charts of Burma coast.
in the *Clyde*, with the sanction of the Government of India, to execute this survey during the season of 1876-77. I also found the Admiralty chart of Tavoy River dangerously erroneous; but, during my brief stay of scarcely three days in all on my outward and homeward journeys, I was enabled to take observations and soundings which, with Mr. Carrington's subsequent assistance, have resulted in our producing a more reliable chart. At Junkseylon I met Captain A. deRichelieu, Siamese Royal Navy, commanding the gunboat *Coronation*, from whom we have obtained an excellent preliminary survey of that island. This survey, as also the corrected chart of Tavoy River, were published on my return to Calcutta.

6. A report on the ports visited was furnished to the Government of India, and will be found in Appendix A. At the close of that report I pointed out the desirability of my taking a cruise for two months in a small steamer along the beaten track through the Mergui Archipelago, with a view of obtaining data to supplement the existing charts with soundings, and of inserting any fresh rocks and shoals, of which dangers the British India Steam Navigation Company's coasting vessels have recently discovered so many. At Rangoon there was just such a vessel as I required—the S.S. *Ava*, of 300 tons, which had been purchased by Government and employed for some years whilst the Burma screw-pile lighthouses were being erected. She was laid up between June 1876 and April 1877; but, for some unknown reason, the authorities of British Burma could not let me have her for the short period suggested. This inspection tour remains to be accomplished at some other time.

7. In Department of Revenue, Agriculture, and Commerce letter No. 410 (Commerce and Trade), dated 10th July 1876, I was directed to proceed to False Point, and, after full enquiry, to report, for the information of the Gov-

ernment of India, how, in my opinion, the sum of Rs. 30,000,—applied for by the Government of Bengal as a loan to the Port Fund for improvements to False Point Harbour,—could be best spent in the interests of the port. For this purpose I left Calcutta on the 25th July 1876, accompanied by Navigating Sub-Lieutenant E. W. Petley, R.N., Assistant Superintendent, 2nd grade; and on my return furnished the Government with the reports in Appendices B, C, and D.

8. On the 5th March 1877 I was deputed to Goa, with instructions to visit the harbours of Carwar and Marmagao with all possible expedition, and report on their relative merits as shelter-giving

Deputation to Goa and visit to the harbours of Carwar and Marmagao.
anchorages during the south-west monsoon. I passed over to Bombay by rail. The Government of Bombay having kindly placed the India Government steamer *May Frere* at my disposal, I proceeded in her to Goa, and reached Marmagao anchorage on the 10th March. Carwar was afterwards visited, and again on the 19th May, at the special request of Government. With the assistance of Mr. Guthrie, commanding the *May Frere*, and Mr. W. H. Searle, I sounded the roadstead and approaches thereto; and after return to Calcutta, having plotted afresh all the coast line and shore details, Mr. Carrington and I have constructed a new chart of Goa and Marmagao. Upon the most careful consideration I came to the conclusion that Marmagao is superior as a natural harbour; and in many respects as regards the practicability of making improvements, it is quite equal to Carwar: this has been reported to the Government (*see Appendix E*).

9. On my return to Calcutta I started on the 30th March 1877 on a previously-arranged tour of inspection of all the ports between Calcutta and Bombay, with the object of testing the charts, the positions of light-houses,

Inspection of the ports between
Calcutta and Bombay.

and to gather information of general use to navigation. The requirements of the ports visited have been communicated to the Department of Revenue, Agriculture, and Commerce; but as this tour was made during the current official year, details regarding it will appear in my next annual report.

10. The following are the instructions issued to the officers in charge of survey parties in regard to the work they were required to execute, together with a few brief remarks upon their various labours.

Instructions to officers in charge
of Survey parties.

11. Having been directed by the Government of India to send two officers to Madras to survey the Roadstead, Navigating Lieutenant Jarrad, with Mr. Falle as Assistant, was deputed to perform the work. He was ordered

Survey of Madras Roadstead.

to make a careful sectional survey of that part of the Madras roadstead and beach which is abreast of the native town and extending to the mouth of the Cooum Creek. The season having far advanced when Lieutenant Jarrad arrived at Madras, and as he was required to be present in Calcutta to proceed with the *Clyde* to her surveying grounds in Burma, there was not sufficient time to carry this out in its entirety; he was, however, able to plot and sectionally sound that part of the coast extending $1\frac{1}{4}$ miles north and south of the screw-pile pier, exhibiting the northern harbour groyne and its effect in arresting the moving coast sand during the continuance of a northerly ocean current for half a year.

12. The survey at Madras was afterwards continued by Navigating Lieutenant G. C. Hammond, who, with Navigating Lieutenant Pascoe as Assistant, arrived there on the 11th February 1877. Lieutenant Hammond was instructed to extend the soundings for $3\frac{1}{2}$ miles to both northward and southward of the screw-pile pier; he was fortunately able to finish the soundings to the southward before the hired steam-cutter broke down, but the work to the northward had to be completed in an open pulling boat. Whilst the Madras survey was proceeding, some questions about Cochin and Beypore were brought forward by the Marine Department of the Government of Fort St. George; and I consequently sent Lieutenant Hammond by rail to those ports to give his opinion: the result will appear in next year's report.

13. Navigating Lieutenant Jarrad in the *Clyde* was ordered to proceed to Amherst, calling *en route* at Diamond Island (Bassein River), to make observations for the purpose of obtaining a meridian distance between that island and Amherst Point Pagoda. This, with Lieutenant

Work proposed for the steamer
Clyde.

Jarrad's observations of last season, would connect astronomically Diamond Island, Rangoon (Elephant Point Obelisk) and Amherst Pagoda—the three principal stations in the Gulf of Martaban essential to the reproduction of a new chart of that locality. On arrival at Amherst he was to survey the approaches and entrance to the Moulmein (Salween) River on a scale of 2·5 inches to the nautic mile. After completing the survey of Amherst, Lieutenant Jarrad was to leave for Diamond Island, re-measuring the difference of longitude between Amherst and that island, thus determining the latter position with regard to the former by the most rigorous method. He was then to proceed to complete the survey of Akyab Harbour and its approaches, which work he was obliged to abandon in the previous year, owing to an outbreak of cholera. The survey of Akyab was to embrace the Oyster Reef and Heckford Patch, upon the completion of which Lieutenant Jarrad was to proceed to Kyauk Phyou, to continue the work commenced there last season.

14. The Commissioner of Arrakan having pointed out that great inconvenience was caused to the public service on account of mail steamers anchoring outside the bar of Sandoway River, Lieutenant Jarrad was directed to visit and

examine the entrance of the river in the *Clyde* on the way from Amherst to Akyab, with a view of ascertaining whether vessels could anchor inside it.

15. Navigating Lieutenant G. C. Hammond, having returned from sick leave in November, was instructed, three weeks afterwards, to proceed to Chittagong

Survey of Chittagong (Kornafuli) River. and survey the entrance of the Kornafuli River on the scale of 4 inches to the nautic mile, from 2 miles northward of Patunga Point to 2 miles southward of Norman's Point.

16. The main object of this survey was to ascertain in what manner it would be most desirable—in view of making the approach to Chittagong River more easy by night,—to remove the lights exhibited at Norman's Point to a more southerly position, in order to render them safe from the encroachment of the sea. During the progress of the survey Lieutenant Hammond was ordered to consider the most effectual plan, consistent with economy, of a re-arrangement of these, or the erection of additional lights, to indicate the entrance to the river for the guidance of vessels approaching the port.

17. On the 15th January 1877, having been informed by Lieutenant Hammond that the necessary preliminary examination had been effected, I

Visit of inspection to the Norman's Point and Kootubdeah lights. proceeded to Chittagong on board the British India Steam Navigation Company's steamer *Kurrachee* and inspected the Norman's Point and Kootubdeah lights in company with Major Smyth, R.E., the

Superintending Engineer; and with Lieutenant Hammond's advice, determined the positions to which the Norman's Point lights should be removed. I also had opportunities of studying locally the question of the lights at Kootubdeah and Norman's Point, as affecting the safety of shipping when approaching Chittagong or navigating the neighbouring coast. My reports on the lights are given in Appendix F.

18. On arrival at Chittagong I found that cholera was epidemic throughout the neighbourhood, and that most of the survey party were suffering from fever and dysentery. Every fresh-water tank had been spoilt by the storm-wave, and healthy drinking water was not procurable;

Abandonment of survey of Chittagong. whilst the surveyors, when fixing in the coast line, came frequently upon heaps of half-burnt or half-buried human corpses. I therefore considered it my duty to direct Lieutenant Hammond to abandon the survey, and we accordingly embarked on board the steamer *Mahratta* for Calcutta, having in tow the steam-cutter *Robin Hood*, covered with canvas and well battened down. On the passage the steam-cutter was unfortunately lost; she had no Engineer, the man engaged at Calcutta having eventually refused to proceed without higher wages. I can only attribute the loss of this boat to the absence of a careful Engineer to look after the engines and boiler; she was filling rapidly but there was time to sling and save her, had not an accident also occurred to the *Mahratta's* boat, which was thus rendered useless, and another had to be lowered; meanwhile the steam-cutter was too far gone, and her hawser parted through the slight pitching of the steamer.

19. In connection with all the above operations and my inspection tours, Hydrographic Notices and Notices to Mariners. Hydrographic Notices,—containing sailing directions for Junkseylon or Salang Island, Mergui Archipelago, Rangoon river entrance, Moulmein

(Salween) River, Kyouk Phyou and False Point,—have been published. Notices to Mariners relating to new lights, buoys, and newly discovered dangers, have also been published and issued to Indian maritime authorities and to foreign Governments.

20. The steamer *Clyde*, after completing the season's work recorded in Section III, was transferred to the Marine Department, as she had proved so unsuitable. A new steamer is about to be built at Bombay Dockyard.

Meanwhile surveying operations will be carried on by boat parties.

21. A large amount of work has been performed in the office. The monthly cash accounts of the survey parties were regularly examined and forwarded to the Comptroller General; whilst the store accounts were submitted to the Examiner of Dockyard Accounts for audit. The number of official letters issued during the year under report amounted to 1,280, and there were 350 office memoranda and demi-official letters sent out, in addition to several lengthy reports. Numerous estimates and statements were also prepared and furnished to the Government of India, the Comptroller General, and the Accountant General of Bengal.

22. A considerable portion of my time, and Staff Commander Ellis's, has been occupied in the careful consideration of a number of nautical questions forwarded to me by the Government of India for report, the most important of which were—

Hindrances to the free navigation of Bassein River, brought to the notice of the Secretary of State by the Liverpool Ship Owners' Association.

Colouring of buoys in harbours.

Rules affecting emigrant ships (for the better protection against fire).

Rules for the measurement of Native craft.

Improvements in signalling on Indian Coasts.

Limits of the ports of Coconada, Masulipatam, and Calicut.

Native Passenger Ships Act of 1876, with reference to long and short voyages and seasons of fair and foul weather.

23. The preparation of a tabular statement shewing the cost of erection and maintenance of all the light-houses and light-vessels of British India, together with their positions, distinctive characteristics, &c., was commenced last year. This duty was assigned to Staff Commander Ellis; the difficulty of getting accurate and exhaustive information has again delayed the completion of the work this year. Staff Commander Ellis has conducted the quarterly examinations in navigation held in Calcutta for Masters and Mates of the Mercantile Marine, and during my frequent absences has remained in charge of the office.

24. The preparation of the Annual Return of Wrecks and Casualties in Indian waters is more difficult than we anticipated when the task was assigned to the Superintendent of the Drawing Branch. But I trust that recent Government orders will cause the needful returns from out-ports to be forwarded to us more quickly and regularly, and thereby the burden of producing a complete wreck return will be made lighter. Mr. Carrington is indefatigable in his exertions to bring about the desired result.

25. In the Compiling and Drawing Branch (full particulars of which are given in Section II) Mr. Carrington's services have been marked with great ability; and I cannot here refrain from expressing the deepest satisfaction that His Excellency the Secretary of State, Lord Salisbury, so readily responded to my application for the services of this gentleman, whose long experience in the Hydrographical Department of the Admiralty renders him a most useful coadjutor and the greatest acquisition to the office of the Marine Survey Department. As an instance of the value of the Drawing Branch, I would mention that a chart shewing the result of Lieutenant Jarad's survey of the Moulmein River entrance was drawn, published and ready for public sale, in less than four months after the return of the *Clyde* from her surveying ground.

26. The organisation of a new office, like the Marine Survey Department of India, required much painstaking and intelligent assistance from all subordinates; and it has been my good fortune to meet with this. From the commencement I greatly benefited by the services of Lieutenant Jarrad, who had been for some time employed in the Hydrographic Office of the Admiralty and had studied its systematic routine.

I have again specially to notice the zeal and constant attention to duty of Mr. Donald Sunder, my Chief Clerk and Accountant, who, in addition to his own work, performed that of the Assistant Clerk for three months. I am glad to record that both Baboos Preonath Mookerjea and Eshan Chunder Doss have always done good service.

27. I regret my inability to announce in this my second yearly report that much progress has been made in establishing at Calcutta a Chart Depôt on a proper footing, or that a mutually favourable agreement has been made with the Admiralty for the requisite supply of charts.

Chart Depot. There is still some hitch about complying with our demands; but, trusting that all differences and hindrances will have vanished before next year, and that our Chart Agency, with a rich store of charts, will then be in full activity, and proving itself a real benefit to the maritime community, and a remunerative branch of this Department, I need only now state that Mr. Dean, the Superintendent of Government Printing, who is appointed Agent for the sale of Charts, has made a good commencement by issuing monthly printed lists of all new charts and hydrographic publications; these are circulated freely in the city and over India, so that the nautical and mercantile public now know where to go to have at least some of their wants supplied.

28. The following appointments occurred during the year under review.
Appointments, furlough, &c. At the request of the Government of India, two officers from the Royal Naval College at Greenwich,—Navigating Lieutenant T. C. Pascoe and Lieutenant W. H. Coombs, R. N.,—were appointed by the Right Honourable the Secretary of State for India to fill posts, vacant in the Department, of Assistant Superintendents, 2nd Grade. These officers arrived at Bombay on the 6th December 1876, and shortly after reported themselves to me. I deputed Lieutenant Pascoe to assist Lieutenant Hammond in the survey of the Chittagong River, and Lieutenant Coombs was ordered to Moulmein to join the Clyde.

29. On the 1st May 1876, Mr. Morris Chapman was granted furlough for one year, and proceeded to Europe. He was absent only six months, when he returned to duty at my request, because we had so few surveyors, and rejoined the Clyde under Lieutenant Jarrad.

30. Navigating Lieutenant Hammond obtained leave on medical certificate for six months, and left for England on the 16th May. He returned to duty on the 22nd November 1876, and was sent to Chittagong and afterwards to Madras; but I regret to record that he again became dangerously ill whilst he was at Madras, and was compelled to proceed to England on one year's sick leave under the advice of the Madras Medical Board. Rather frequent ill health seems an unavoidable drawback in the case of officers who were not acclimatised to India in the days of their youth. Over-exertion and exposure, in the cause of duty in unhealthy places, have thus more than once incapacitated Lieutenant Hammond.

31. I was also unfortunately deprived of the services of another of my officers. Sub-Lieutenant Petley, whilst employed on the survey of Moulmein River, became ill, and was obliged to return to Calcutta. He appeared before a Medical Board, and proceeded to England on the 15th March 1877 on eight months' furlough. He had been three years in the Persian Gulf previously to joining our Department, in which he has been a hard-working Assistant and generally in unhealthy localities.

32. Consequent on the transfer of the schooner *Constance* to the Marine Department, as she was found unsuited for surveying work, and on the appointment of two additional officers of the Royal Navy, it became necessary to transfer Mr. G. W. Hill and Mr. T. H. Baker,

Changes in personnel.
Executive Officers, to the Bombay Marine, whence their services were lent to this Department. Both the officers, however, preferred to resign their appointments, Mr. Baker having since obtained the post of Master Attendant of Paumben.

33. I am bound to speak in the highest terms of praise of the excellent charts produced by Navigating Lieutenant Jarrad,

Good services.
R.N., and of the thoroughness of his work in every respect; he is training the juniors in scientific surveying and draughting, in which he is himself so accomplished. No such admirable charts as those of Rangoon and Moulmein River entrances have yet been produced in this country; they will be of priceless value hereafter for comparison in the hands of future Surveyors.

34. I wish particularly to record the good services of Dr. Armstrong, who in cases of sickness has been most unremitting in his attention to the officers of the Department and the crew of the steamer *Clyde*. Lieutenant Jarrad has also spoken most favourably of this officer as Surgeon-Naturalist, and brings to my notice the importance of having a Medical Officer with each surveying expedition. Dr. Armstrong has this year furnished a full report of his gleanings in natural history during 1875-76, which will be found in Appendix K. He has also given in a brief summary of results for the year under review. Every opportunity of using the dredge on the *Clyde's* short journeys from port to port was taken advantage of, but as the *Clyde* is not fitted with the appliances necessary for a thorough physical examination of the sea (*vide* my Report of last year), sounding or dredging in depths of over 50 or 60 fathoms was impracticable, thus very few marine specimens were obtained.

35. On my recommendation, and to fill existing vacancies, Mr. Morris Chapman, Assistant Superintendent, 2nd Grade,

Promotions.
and Mr. P. J. Falle, Assistant Superintendent, 3rd Grade, were promoted to Assistant Superintendents, 1st and 2nd Grades, respectively. In bringing the services of these officers to my notice, Lieutenant Jarrad wrote as follows:—

"Mr. Chapman has performed his duties with zeal and ability, and in every way to my satisfaction, and is a thoroughly steady and reliable officer. As a surveyor, he is careful and accurate; and he has taken every opportunity of perfecting his knowledge of the several branches of his profession. He proved to be as useful a member of the surveying staff as any of my assistants, and I trust that you will be pleased to take into your favourable consideration Mr. Chapman's claims for promotion to the post of Assistant Superintendent, 1st Grade, rendered vacant by the death of Sub-Lieutenant C. George, R.N. Mr. P. J. Falle is a valuable officer, and possesses qualifications far in advance of those officers of the Marine whose services were placed for a time at the disposal of this Department. He has had a good mathematical education, is quick and intelligent, observes and computes well, and is a fair draftsman. Under these circumstances, I deem it my duty to state my opinion, that Mr. Falle is most worthy of advancement."

A. DUNDAS TAYLOR,

Commander (late I. N.), Superintendent Marine Survey of India.

On the 31st March 1877, the strength of the Marine Survey Department was as follows:—

SUPERINTENDENT'S OFFICE.

Superintendent of Marine Surveys	...	Commander A. Dundas Taylor, I.N., F.R.G.S.
Deputy Superintendent, 1st Grade	...	Staff Commander J. H. Ellis, R.N.
Head Clerk and Accountant	...	Mr. Donald Sunder.
Clerk	...	Preonath Mookerjee.
Copyists	...	Eshan Chunder Doss. Bidhoo Bhushun Dey.

COMPILING AND DRAWING BRANCH.

Superintendent	...	Robert C. Carrington, Esq., F.R.A.S.
Head Draftsman	...	Kally Dass Seal.
Draftsman	...	Thomas Ribeiro.
"	...	Rajendro Nath Palit.
"	...	Thomas Smith.
Chart Clerk	...	A. C. Smith.

One chart mounter, one duftary, one duffadar, four peons, and two menials.

EXECUTIVE STAFF OF SCIENTIFIC OFFICERS.

Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., F.R.G.S.	Deputy Supdt., 2nd Grade, Commanding I. G. S. <i>Clyde</i> .
Navigating Lieutenant G. C. Hammond, R.N., F.R.G.S.	Asst. Supdt., 1st Grade.
Morris Chapman, Esq., late I. N.	Asst. Supdt., 1st Grade, attached to I. G. S. <i>Clyde</i> .
Vacant	Asst. Supdt., 1st Grade.
Navigating Sub-Lieutenant E. W. Petley, R.N.	Asst. Supdt., 2nd Grade, attached to I. G. S. <i>Clyde</i> .
Navigating Lieutenant T. C. Pascoe, R.N.	Asst. Supdt., 2nd Grade, attached to I. G. S. <i>Clyde</i> .
Lieutenant W. H. Coombs, R. N.	Asst. Supdt., 2nd Grade, attached to I. G. S. <i>Clyde</i> .
P. J. Falle, Esq.	Asst. Supdt., 2nd Grade, attached to I. G. S. <i>Clyde</i> .
Vacant	Asst. Supdt., 3rd Grade.
Vacant	Asst. Supdt., 3rd Grade.

MEDICAL OFFICER AND NATURALIST.

Surgeon J. Armstrong, B.A., F.L.S. ... Attached to I. G. S. *Clyde*.

A. DUNDAS TAYLOR,
Commander (late I. N.), Superintendent Marine Survey of India.

S E C T I O N II.

COMPILING AND DRAWING BRANCH.

THIS branch, under the superintendence of Mr. R. C. Carrington, has turned out a large mass of work during the past twelve months. In addition to the finished drawings prepared from the original surveys for the purposes of engraving and photozincography, several new charts have been compiled from the best existing materials, incorporating corrections and additions by myself, the officers of the Department, and other Marine authorities. These were sheets badly wanted, and have been eagerly sought for by masters of vessels visiting the various ports.

A vast amount of extra work has been thrown on this branch of the Department in the preparation of the wreck chart and returns for the previous year, involving a large correspondence, as well as copies of all wreck and casualty returns, for transmission to the London Board of Trade.

The correspondence in this branch has increased in a most marked manner. During the past year 434 official letters were despatched, besides a large number of semi-official notes and memoranda.

The following Notices to Mariners, &c., have been attended to, and, where affecting the charts in store, the corrections have been systematically carried out:—

	NOS.
English Notices to Mariners and Hydrographic Notices	193
Spanish <i>Aviso a los navegantes</i> ...	393
Dutch <i>Berigt aan zeevarenden</i> ...	823
American Notices to Mariners and Hydrographic Notices	513
Chinese Notices to Mariners ...	15
German <i>Kundmachung für seefahrer, and Hydrografische nachricht</i>	326
Indian Government Notices to Mariners ...	16

Great efforts have been made to issue charts incorporating the latest corrections and additions, and the junior hands or apprentices have, under the strictest supervision, been employed in correcting the various sheets for newly discovered dangers, new lights, buoys, &c., and during the twelve months 3,279 charts have been corrected.

A new edition (1877) of the List of Light-houses and Light-vessels in British India, with an index chart showing the position of the various lights, and a new catalogue of charts have been issued.

In addition to the above, a large amount of responsibility is thrown on the Superintendent of this branch, who, having no European assistant, has to personally supervise the whole of the outturn of work in the minutest details.

All projections and compilations have to be carried out by himself, and the training of the drawing staff is necessarily of a most tedious description, as Hydrographic delineation requires not only the greatest care, but is entirely distinct from any other style of drawing. Mr. Carrington, however, reports most favourably on the progress made in the drawing room, more especially in regard to the draftsmen, Babu Kally Dass Seal and Mr. Ribeiro; the former deserves praise for his care and attention to his duties, and has turned out some well finished drawings: Mr. Ribeiro has exhibited a large amount of intelligence, is a careful draftsman, and has rendered valuable assistance in connection with the wreck and casualty returns.

It is hoped that, after two or three years' steady application to their duties, the junior hands employed may prove good hydrographic draftsmen.

In connection with this section of the Department, I beg particularly to call the attention of the Government to the very excellent manner in which the photozincographic sheets have been turned out from the Surveyor-General's Office. The care and labour bestowed upon this, and the unvarying courtesy of Captain J. Waterhouse, I would wish specially to record.

The following statement shows the nature of the work performed in this branch from the 1st of April 1876 to the 31st March 1877.

No. of Chart.	Title.	Size.	Scale.	REMARKS.
106	Madras Roadstead, by Navigating Lieutenant F. W. Jarrad, R.N., 1876.	D.E. Inches.	M=20'0 D.E.	400 copies photozincographed. A reduction from the survey on a scale of 30 inches to a mile. No chart has hitherto been published of this roadstead; and was much required for navigating purposes as also for engineering works.
115	False Point to Mutlah River, showing the approaches to the Sandheads, 1877.	D.E.	M= 0'3	400 copies photozincographed. This sheet has been compiled from the latest Government surveys. It was much required by the pilots and masters of vessels making the approaches to the Sandheads.
1163	Puket or Tonkah Harbour with part of the east coast of Junkseylon, from the survey by Captain A. deRichelieu, H.M.'s Siamese Navy, 1876.	D.E. 4	M= 3'0	250 copies photozincographed. This work is entirely new, no survey of the harbour having previously been published, and no indication of the existence of this harbour shown on the Admiralty Charts.
1164	Salang Island or Junkseylon, by Captain A. deRichelieu, H.M.'s Siamese Navy, 1876.	Atlas	M= 1'0	400 copies photozincographed. Entirely new work, no previous examination of the island having been made. The existing charts are extremely erroneous, and this sheet supplies a want sadly felt by masters of vessels visiting this coast.
151	Tavoy River, 1876	-- D.E. 2	M= 0'75	300 copies photozincographed. This chart has been compiled from the original sketch by the late Lieutenant Moresby of the Bombay Marine with additions and corrections by Commander A. D. Taylor, Superintendent of Marine Surveys, and Mr J. James, Commanding B. I. S. N. Company's S.S. <i>Mahratta</i> 1876. The chart is by no means an exhaustive survey of the place, and has been issued only as a preliminary sheet, the one published by the Admiralty having been found incorrect.
	Index map of India, 1876	-- D.E. 8	D= 0'5	210 copies photozincographed. To accompany the general report for 1875-76. Showing the surveys completed by the officers of the Marine Survey Department, and sheets published from the results of these surveys, and those compiled from other authorities.
	Chittagong River, 1876	-- D.E. 2	M= 4'0	Copy of the original survey by Navigating Lieutenant G. C. Hammond, R.N., 1876, for transmission to the Hydrographer of the Admiralty.
43	Goa and Marmagao Roadsteads, 1877	D.E. 2	M= 2'0	240 copies photozincographed. Compiled from observations by Commander A. D. Taylor, based on a true bearing and distance of St. George's Islands from the light-house given on the Great Trigonometrical Survey, with additions from the surveys of Lieutenant J. Garling, Captain D. Inverarity and Commander C. W. Montrou, I.N. This sheet supplies a long-felt need, no chart having hitherto existed of this most important anchorage.
1165	False Point anchorage, by Navigating Lieutenant G. C. Hammond, R.N., 1876.	Imperial	M= 6'0	300 copies lithographed from the finished drawing prepared in this office. Issued for local purposes.

No. of Chart.	Title.	Size.	Scale.	REMARKS.
			Inches.	
159	Kopah Inlet, 1876	... D.E. — 2	M= 0'75	200 copies photoincographed. The sheet has been compiled from a sketch by Commander A. D. Taylor, a Siamese topographical plan, and observations by J. T. Lewis, R.N.R., Commanding S.S. <i>Arabia</i> . This is entirely new work, no indication having hitherto existed of this port on the Admiralty Charts. The sheet is issued as a preliminary one.
11	Magnetic chart of the Indian Ocean, showing the curves of equal magnetic variation for 1877.	D.E. — 8	D= 0'20	240 copies photoincographed. Compiled from observations by the officers of the Great Trigonometrical Survey of India, the Admiralty Chart of Curves of Equal Magnetic Variation, and observations by the officers of the Marine Survey Department. The sheet shows, by means of tinted spaces, the approximate annual change of variation.
246	Madras Roadstead, by Navigating Lieutenant F. W. Jarad, R.N., 1876.	2 D.E.	M= 30'0	Copy of the survey for the use of the Madras Government.
246	Ditto ditto ...	2 D.E.	M= 30'0	Copy transmitted to the Hydrographer of the Admiralty.
43	Goa and Marmagao Roadsteads, 1877.	D.E. — 2	M= 2'0	For the use of the Superintendent of Marine Surveys.
43	Ditto ditto ...	D.E. — 2	M= 2'0	For the use of the Government of India.
298	False Point anchorage and the mouths of the Mahanudi River, by Navigating Lieutenant G. C. Hammond, R.N., 1876.	D.E.	M= 3'0	Copy of the original survey for transmission to the Hydrographer of the Admiralty.
1165	False Point anchorage, by Navigating Lieutenant G. C. Hammond, R.N., 1876.	Imperial	M= 6'0	Ditto ditto ditto.
15	Kurrachee to Vingoria, 1876 ...	D.E.	D= 3'2	400 copies photoincographed, issued for local purposes.
15a	Vingoria to Cape Comorin, 1876	D.E.	D= 3'2	350 ditto ditto ditto.
15b	Cape Comorin to Coconada, 1876	D.E.	D= 3'2	400 ditto ditto ditto.
104b	Nursapoore Point to Ramiapatnam.	Atlas	M= 0'25	200 copies photoincographed from the Admiralty Chart, issued for local purposes.
104c	Ramiapatnam to Madras ...	D.E.	M= 0'25	Ditto ditto ditto.
104d	Madras to Point Calimere ...	D.E.	M= 0'25	Ditto ditto ditto.

Miscellaneous.	For what purpose executed.
Tracings of part of Rangoon river, showing the lights	For submission to Government.
Reduction of Alguada Head by Lieutenant Garling, and other tracings, &c., from the Surveyor General's Office.	For office use.
Reduction and tracing of Perak river by Captain H. Grey.	For transmission to the Hydrographer of the Admiralty for the purpose of correcting the Admiralty Charts.
Inserting fathom lines and coast line on 30 sheets of Bahrein Harbour.	For issue and sale.

Miscellaneous.		For what purpose executed.
Tracing of Junkseylon island	...	For Captain A. deRichelieu's Queries and Remarks.
Lakadivh islands	...	Corrections and additions for transmission to the Hydrographer to the Admiralty.
Tracing of plan of buoys in Hooghly River	...	For office use.
Copy of specimen of Trinity House buoys	...	For office use.
Tracing of Mr. Harris's survey of False Point anchorage.		For Bengal Government.
Paumber Pass	...	Corrections and additions for transmission to the Hydrographer to the Admiralty.
Tracing of six outline copies of Rangoon river by Navigating Lieutenant F. W. Jarrad, showing the proposed re-arrangement of the lights and buoys.		To accompany Commander Taylor's report.
Twenty-five copies of Kutubdea Light-house, showing the arrangement of the lighting apparatus.		Ditto ditto
Reduction of Navigating Lieutenant F. W. Jarrad's survey of Rangoon river.		For 5th sheet, India.
Tracing chart of winds and currents in Arabian Sea	...	For Star line steamers.
Reduction of Puket Harbour, Junkseylon	...	For office use.
Buoyage in Kyuk Phyoo Harbour	...	For transmission to the Hydrographer to the Admiralty.
Buoyage in Arracan river	...	Ditto ditto
Tracing of Lieutenant Whish's survey of Bombay Harbour for comparison with Lieutenant Palmer's chart.		For Report on Bombay Harbour.
Copy of sections of Bombay Harbour	...	To illustrate report on Bombay Harbour.
Reduction of Lieutenant Lloyd's, Mr. Obbard's, Lieutenant Hammond's and Mr. Harris's surveys of False Point anchorage.		To illustrate the changes that have taken place in the anchorage. To accompany Commander Taylor's report.
Reduction of map of False Point and Dhumrah River	...	For office use.
Copy of plan of Hooghly river	...	For the Government of India.
Copy of alterations of buoyage in Bombay Harbour on Lieutenant Whish's original sheet.		For office use.
Charts showing proposed arrangement of lights at the Sandheads.		To accompany Commander Taylor's report.
Reduction of Mr. Laycock's survey of Hooghly River	...	For office use.
Triangulation sheet of Chittagong	...	For Navigating Lieutenant G. C. Hammond, R. N.
Tracing of portion of Rangoon river surveyed by Navigating Lieutenant F. W. Jarrad for showing patch	...	For Navigating Lieutenant F. W. Jarrad, R. N.
Plan of Goa Head and copies of memoirs, extracts, &c., by Lieutenant Garling, copied from documents in the Surveyor General's Office.		For the compilation of sheet of Goa and Marmagao Roadsteads.
Reduction of Navigating Lieutenant G. C. Hammond's survey of Chittagong.		For comparison with Commander Lloyd's and Mr. Pearson's surveys, to accompany Commander Taylor's report.
Copy of plan of Colombo Harbour Works by Sir John Coode.		For transmission to the Hydrographer of the Admiralty.
Reduction of Colombo Harbour Works for correction of the charts.		For office use.
Lines showing the water-shed of Goa	...	For Commander Taylor's use.
Colouring a large number of charts for lights, &c., &c.		

SECTION III.

SURVEYING OPERATIONS.

(SEASON 1876-77.)

(a)—MADRAS ROADSTEAD.

UNDER orders of the Government of India conveyed in Department of Revenue, Agriculture, and Commerce letter *Personnel* No. 674 (Surveys), dated the 16th August Navigating Lieutenant F. W. Jarrad, R.N., 1876, the officers named in the margin were Deputy Superintendent. despatched to Madras to execute a survey of Mr. P. J. Falle, Assistant Superintendent, 2nd grade. the Roadstead.

On arrival at Madras, on the 9th September 1876, Lieutenant Jarrad at once proceeded to report himself to Colonel Farewell, Officiating Deputy Chief Engineer to the Government of Madras in the Public Works Department, under whose supervision the Harbour Works were being carried out. The Master Attendant of Madras and Mr. Thorowgood, the Engineer in charge of the Harbour Works, were also called upon, who gave all necessary information and assistance.

Lieutenant Jarrad reported to me that there was no tide-gauge ready, although representations had been made to the Government pointing out the urgent necessity for erecting one.

A plan was prepared by Lieutenant Jarrad, on a scale of 200 feet = one inch, of the Esplanade and foreshore extending $1\frac{1}{4}$ miles north and south of the screw-pile pier, and the necessary points for sounding were fixed. The

Survey of Madras Roadstead. plan was projected on a base line measured by the Harbour Works Engineers, and the details of the town work reduced from that survey, which is on a scale of 100 feet to one inch. There was some

delay in commencing the sounding work in consequence of the steam-cutter hired by the Harbour Works authorities not being ready, and the tide-gauge not being erected.

Want of a proper tide-gauge at Madras. To explain fully the difficulty experienced in erecting a proper tide-gauge at Madras, I give the following extract from a letter received from Lieutenant Jarrad :—

"An ordinary gauge cannot be used in such a swell as experienced, even on the calmest day, at Madras. As reported in my letter dated the 10th September, a telegram was prepared by Mr. Thorowgood requesting the immediate sanction of the Government to his being allowed to sink a well on the beach, which should communicate with the sea at a depth of four fathoms, by means of piping fed along the screw-piles of the pier; it being proposed to construct a gauge in the well as nearly as possible of the same pattern as those used so successfully by Lieutenant Baird, R.E., on the Kattywar Coast, former gauges fixed at the T head of the Madras pier having proved failures. It was ultimately discovered, however, that by some misunderstanding or oversight the telegram was not sent out, thereby causing a delay of nearly three weeks.

"There appears now to be some difficulty in obtaining the piping, which was supposed to be in store, and the season is too far advanced to admit of any hope of constructing the well-gauge in time.

"In the meantime Captain J. H. Taylor (the Master Attendant), seeing how urgent the matter was, and that the execution of a survey this season depended wholly upon the expedition with which a gauge could be fitted, at once commenced an attempt at again setting up one on the pier head. He hoped that by altering the form of the float, and making other modifications in the method of leading the piping, to get sufficiently accurate results, so as to enable the soundings to be reduced to a minimum of error. Unfortunately, however, the force of the waves, even at $4\frac{1}{2}$ fathoms, is so great, as to cause the float to oscillate as much as 4 or 5 feet. Captain Taylor is now fitting the pipe with a diaphragm; and should this fail to have the desired effect, I can see no hope of obtaining the soundings before the north-east monsoon sets in; for on this gauge we now solely depend."

Lieutenant Jarrad afterwards reported that, since fitting a diaphragm in the piping, the tide-gauge had worked satisfactorily, and the heights of the tide had been registered every 15 minutes both by day and night, and the observations have since been deposited in this Department for future reference.

The result of this survey is an elaborate chart showing the foreshore and the extension of the line of beach seaward produced by the new works. The soundings have been sectionally taken in lines 250 feet apart over the principal portion of the sheet, and can be used for engineering purposes; the remainder of the sounding lines were 400 feet apart, the whole being carried seaward to the 10-fathom line.

Extent of survey of Madras Roadstead.

Lieutenant Jarrad and Mr. Falle returned to Calcutta on the 29th October 1876.

(a. bis)—MADRAS ROADSTEAD.

THE survey work at Chittagong having been abandoned on account of sickness amongst both officers and men, Navigating Lieutenant G. C. Hammond, R.N., accompanied by Navigating Lieutenant T. Pascoe, R.N., was ordered to proceed to Madras to extend Navigating Lieutenant Jarrad's survey of the Roadstead to a distance of $3\frac{1}{2}$ miles north and south of the screw-pile pier, and off shore to the 10-fathom line, on a scale of 600 feet = 1 inch.

Survey of Madras Roadstead.

The Indian Government steamer *Tenasserim* being about to leave for Madras with troops, advantage was taken of this opportunity, and Lieutenant Hammond's party left on the 3rd February, arriving there on the 10th.

Upon calling on the Assistant Secretary, Public Works Department, Lieutenant Hammond was referred to Mr. Thorowgood, the Engineer in charge of the Harbour Works, who rendered all possible assistance.

It was found that the tide-gauge used by Lieutenant Jarrad and placed on the outer side of the T pier head had been washed away; at Lieutenant Hammond's request another was ordered by the Master Attendant to be erected, to be placed in the centre of the pier head. The gauge consisted of an iron tube bent at the bottom in the form of a U, and diaphragms were introduced to compensate for oscillations caused by the heavy swell generally experienced at Madras. The tidal observations, commenced on the 21st February, were carried on day and night until the 16th April, the observations being recorded every 15 minutes.

The steam-cutter was not launched until the 24th February, this being the first opportunity of getting her into the water on account of the heavy surf, and it was then found that her engines required repairing before she would be fit for use.

Owing to these delays, the sounding work was not commenced until the 28th February; but in the mean time the shore work was being proceeded with. A base line, commencing from Lieutenant Jarrad's south base, was laid down as far as the Ice House, and sectional points laid off and marked ready for the purpose of erecting section poles and flags.

Sounding was carried on daily; but this—owing to having a short crew and only one good leadsmen, and the sea-breeze setting in about 10 or 11 o'clock—could not be continued for more than four or five consecutive hours: a heavy surf and swell then set in all along the beach, which rendered it impossible to sound so closely as was required.

The steam-cutter caused considerable anxiety, as the tubes being old were continually bursting, and none were obtainable at Madras. However, the sounding was completed $3\frac{1}{2}$ miles south of the T pier head by the 12th March, 27 lines, 600 feet apart, having been run.

The steam-cutter was then put under repairs; and while this was being carried out, the north base was continued from Lieutenant Jarrad's north base station, and sectional points laid off ready for the section poles. Two days were employed in sounding over the portion previously surveyed of the north surf bank, to ascertain if any changes had taken place in the configuration of the bottom; but none could be detected.

On the 26th March Lieutenant Hammond informed Mr. Thorowgood that the cutter was of no further use, in consequence of the tubes constantly bursting, and it was therefore returned to the Harbour Works authorities.

The remainder of the sounding, extending about $1\frac{1}{2}$ miles to the northward of Lieutenant Jarrad's work, was executed in an open pulling boat; 12 lines, 600 feet apart, were run out to a depth of 10 fathoms.

(b)—CHITTAGONG (KORNAFULI) RIVER.

A SURVEY party, consisting of staff marginally noted, in charge of Navigating Lieutenant G. C. Hammond, R.N., left Calcutta for Chittagong on the 17th December 1876, proceeding through the Sunderbuns in a flat towed by I. G. paddle steamer No. 1, and having in tow the steam-cutter *Robin Hood*, in which the sounding work was to be carried out.

The party reached Chittagong river on the 26th December, and camped on Flagstaff Hill at the entrance, which place was selected as one of the points of main triangulation.

Survey of Chittagong river.

On the 28th December a base of 4,152 feet was measured on the mud flat to the westward of the flagstaff, and the triangulation extended from the eastern shore to Patunga flagstaff on the west and the light-house to the south.

The work was commenced under great difficulties, several of the men having contracted fever whilst passing through the Sunderbuns, others, natives of the place, deserting on account of the illness of their families and friends at the town of Chittagong.

With this reduced staff, the triangulation was completed, and stations erected for sounding, from the entrance of the river as far as the upper tripod to the north to two miles south of Norman's point lights and two miles north of Patunga point. The sounding of the river was completed from Jooldea village to the bar; the banks of the river and coast line south of Norman's point lights were also laid down on the charts. The examination comprised nine miles of coast line and about three square miles of water sounded.

During the whole period this work was being performed, the steam-cutter was continually breaking down, and most of the men were ill, cholera and fever being epidemic throughout the neighbourhood. On the 18th January 1877, I arrived at Chittagong, and ascertaining how very unhealthy the place was, I ordered Lieutenant Hammond to abandon the work and to proceed to Calcutta by the steam-ship *Mahratta*, where the party arrived on the 25th January. On the passage the steam-cutter *Robin Hood*, which was in tow of the steamer, was lost.

In page 4 of this report I have stated that the object of this survey was to ascertain how best to remove the Norman's point lights from their present positions, to ensure their safety from the encroachment of the sea. It is therefore only necessary for me to mention that the partial examination made by Lieutenant Hammond was sufficient to indicate the changes that have taken place at the entrance to the river, and to enable me to form an opinion as to the best site for the lights.

BURMA COAST.

THE Clyde, with staff marginally noted,

Personnel.

Navigating Lieutenant F. W. Jarrad, R.N., Deputy Superintendent, 2nd grade, commanding.

Mr. M. Chapman, late I. N., Assistant Superintendent, 1st grade.

Navigating Sub-Lieutenant E. W. Petley, R.N., Assistant Superintendent, 2nd grade.

Mr. P. J. Falle, Assistant Superintendent, 2nd grade.

Lieutenant W. H. Coombs, R.N., Assistant Superintendent, 2nd grade (joined on 25th December 1876).

broke down, and it was not until the 25th that they were again ready. On account of the unsettled state of the weather, observations for measuring a meridian distance could not be obtained, and the *Clyde* consequently left Port Dalhousie for Moulmein on the 29th November. Coaling and making all necessary arrangements for the survey detained the vessel at Moulmein till the 3rd December, when she proceeded to Amherst, and work was commenced on the 6th December. From the 23rd of November up to the time of Lieutenant Jarrad's arrival at Moulmein he was suffering from a severe attack of ophthalmia and rheumatism, caused by exposure at Diamond Island.

Lieutenant Jarrad reported that much difficulty was experienced at Amherst in erecting a tide-gauge, owing to the exposed nature of the only available positions, and the great strength of the tidal stream, which caused it to be frequently swept away : thus the work was

(c)—Survey of Moulmein River.
much delayed. The same difficulty was felt last season during the course of the survey of Rangoon River.

The importance of erecting self-registering tide-gauges at Elephant Point (Rangoon) and Amherst (Moulmein), so that a series of uninterrupted tidal observations could be made, for at least two years, cannot be too strongly urged : I trust therefore the Government will cause them to be erected with as little delay as possible. The observations would be of the greatest value, and there would be no difficulty or delay in examining the rivers at any time.

Want of self-registering tide-gauges at Elephant Point (Rangoon) and Amherst (Moulmein).
Between the 6th and 22nd December the main triangulation was obtained, a base of 7,366 feet having been measured on the extensive Beloo Gywoon sands, which lie between Amherst and the island of Beloo Gywoon. Sounding stations were erected ; a true bearing and magnetic variation observed (*see Appendix H*) ; some portion of the coast and off-lying banks surveyed, and the whole protracted. On the 22nd the *Clyde* proceeded to Moulmein for stores, coals, &c., and was there till the 27th. On the 25th Lieutenant W. H. Coombs, R.N., Assistant Superintendent, 2nd grade, arrived by steam ship *Himalaya* and joined the *Clyde*. The remainder of the month was spent at Anchoring Creek (about ten miles north of Amherst), and work was confined to delineating the coast and numerous sandbanks, with which the river is encumbered.

On the 1st January a party with Sub-Lieutenant Petley, Lieutenant Coombs and Dr. Armstrong was landed on the south side of Beloo Gywoon, and the coast and foreshore of the island five miles westward were surveyed. Sub-Lieutenant Petley on his return was so unwell as to be unable to continue his surveying duties ; from that time until the end of the month, he was only on one occasion able to resume them, and on the 15th of the following month left for Calcutta, to appear before a Medical Board, and eventually proceeded to England on eight months' furlough.

In consequence of the great strength of the tidal stream during spring-tides, sounding work was very much impeded ; and the operations were then confined to shore work. Indeed it might be said that throughout the survey sounding was performed during neap tides. The continuous thick fogs in January and February were the cause of sometimes two or three weeks at a time being lost. The work was thus not completed till the 24th March.

The result of this survey is an elaborate, sectionally sounded, double elephant sheet, and comprises 105 square miles of water closely examined, and 36 miles of coast trigonometrically laid down.

Extent of survey of Moulmein River approaches.

Whilst at Amherst Lieutenant Jarrad obtained a true bearing of Double Island Light-house from Amherst Point, and discovered it to be $1\frac{1}{2}$ miles to the westward of its true position, notwithstanding the island and the adjacent coast had already been shifted a distance of $4\frac{1}{2}$ miles to the eastward of the positions shown on the Admiralty charts. This is a most important determination, and the information has been forwarded to the Admiralty.

(d)—Corrected position of Double Island light on Admiralty sheet No. 823.

Lieutenant Jarrad was ordered to make the necessary observations for measuring a meridian distance between Amherst Point Pagoda (Moulmein River) and Diamond Island (Cape Negrais). The meridian distance was measured with eight chronometers, the errors of which were determined by six sets of observations of equal altitudes of the sun's limb and centre, observed at Amherst Point on the 11th and 16th February, and at Diamond Island flagstaff on the 14th February. The travelling rates deduced from the above observations, when applied, gave the results shown in Appendix H*.

(e)—Meridian distance between Amherst Pagoda and Diamond Island.

The range of the difference in the results of the meridian distances as shown by each of the eight chronometers was 0.652 seconds. Whilst at Diamond Island a true bearing was obtained of the pagoda on Cape Negrais, and observations taken of the magnetic variation. See Appendix I.

On the 31st March the *Clyde* proceeded from Diamond Island to Akyab. The shore was kept in sight the whole distance, in order to obtain soundings of moderate depth in which to use the dredge; but although every opportunity was taken advantage of, very few specimens were obtained.

Dredging between Diamond Island and Akyab.

On arrival at Akyab, Lieutenant Jarrad found that cholera had been spreading for some time among the shipping, causing the death of several masters of vessels. Dr. Armstrong's services were required to attend to some of the European inhabitants, a violent outbreak of this fatal disease having occurred in the station.

Outbreak of cholera at Akyab.

After taking every precaution for carrying on survey work, Lieutenant Jarrad commenced erecting sounding stations, and proceeded with a party to Borongo, to map the western shore of that island. The main triangulation, extending over 340 square miles, and 10 miles of the coast of the harbour of Akyab, was plotted on a scale of 3 inches = one nautic mile. As it was almost impossible to carry on the work under the depressing influences caused by the number of deaths occurring around, it was considered advisable to relinquish the survey, and Lieutenant Jarrad was accordingly ordered to proceed to Kyook Phyoo. The circumstances under which this important survey was abandoned were precisely the same as

Survey of Akyab.
(f)—Main triangulation and portion of coast of Akyab.

last season, and it is to be much regretted that it could not be accomplished. I give the following remarks by Lieutenant Jarrad, with which I fully concur, regarding the survey of Akyab harbour and the present published Admiralty chart :—

"In my opinion this survey should be completed immediately the means at the disposal of the Department will admit of doing so. The present published Admiralty chart is so incorrect as to be quite useless; indeed, it is evident that it has been published from a sketch of the very roughest description, and *not* a survey. Several wrecks have occurred near Akyab lately; and as a place of export for rice it is much frequented. Its importance, too, as a harbour of refuge for vessels on the Arracan Coast in bad weather leads me to urge the necessity for a complete survey, such as was contemplated, being made of this fine harbour as soon as possible."

There now remained only one week of the working season, and this time was spent in dredging in the shoal water along the sea-face of the Western Borongo and examining the shoals in Kyouk Phyoo harbour, correcting the coast and foreshore, and making all additions possible to the published Admiralty plan of Kyouk Phyoo. The corrections and additions were plotted on a dry proof of the plan, and comprised $5\frac{1}{2}$ square miles of water examined and 5 miles of coast surveyed; magnetic observations were carefully taken, the result being shown in Appendix J.

(g)—Additions and corrections, Kyouk Phyoo harbour.

It was intended that on the way to Akyab, Lieutenant Jarrad should visit and examine the entrance to Sandoway River, in order to ascertain whether steamers could anchor inside the river. I regret this work could not be done, as the season had already so far advanced when the *Clyde* left Moulmein.

On the passages round the coast of Arrakan and Burma the *Clyde* constantly obtained soundings for testing the accuracy of the present Admiralty charts, the deplorable state of which is far worse than I have hitherto thought.

(h)—Additional soundings on Admiralty charts.

However, these soundings have been plotted in connection with the coast as at present delineated.

The result of the season's work in the *Clyde* is, I consider, highly satisfactory, and reflects great credit on Lieutenant Jarrad and all concerned in the survey under his orders.

A. DUNDAS TAYLOR,

Commander (late I. N.), Superintendent Marine Survey of India.

APPENDICES.

A.

Memorandum of an Inspection tour through the ports of British Burmah by the Superintendent of Marine Surveys, in the months of April and May 1876.

Akyab was the first port touched at. There I found the *Clyde*, and Lieutenant Jarrad narrated the circumstances of the sad death of Navigating Sub-Lieutenant Charles George, R. N., from cholera. Lieutenant Jarrad and Dr. Armstrong, under the advice of the Station Surgeon, took measures to prevent the spread of the disease. As cholera was very bad in Akyab and all the neighbouring villages, I directed Lieutenant Jarrad to quit the place with the *Clyde* as soon as practicable, and to survey in the neighbourhood of Kyouk Phyoo.

Moulmein (or rather the port of Amherst at the river entrance) was one of the places about which complaints had been received from the British India Steam Navigation Company that some of their vessels had grounded near the entrance. I found that Mr. Dodd, the Master Attendant, and Mr. Law, the River Surveyor, had been instructed to make arrangements for my inspection of the river entrance in some vessel. The buoy vessel had been named, but she was in dock having sprung a leak. The Master Attendant therefore chartered the steam tug *Defiance* for a day, and I proceeded with the abovenamed officers and two or three experienced pilots down the river on the 15th April. The result of this inspection was that (by common consent of the nautical men on board) the red buoy marking the north side of the entrance was moved a little northward, thus defining the bar channel to be (as it was in reality) rather broader than before and rendering steerage in the strong cross tidal currents easier both for the inward and outward passage of a vessel.

Amherst port has never been properly surveyed. The late Mr. Pearson of the Bengal Marine examined the Moulmein river in 1865 (as stated by me in a former report upon Moulmein,) but no steps were taken by the Marine authorities of that day to have the Admiralty chart corrected by this fresh though incomplete survey. After having scrutinized the Admiralty chart on the spot and observed its incorrectness, its incompleteness, and that it shows not a trace of the lofty hills which are so conspicuous a feature above Amherst Point and are used as leading marks by pilots, and considering also the smallness of the scale adopted by Lieutenant Fell, I. N., who made the sketch in 1842, I am of opinion that no large port of British India so much requires to be properly surveyed and mapped. When once a good survey is published, the River Surveyor will be able to note properly the changes occurring in channels and banks, and to alter accordingly the positions of the buoys, at the same time indicating that alteration on the chart. Now he is labouring under the great disadvantage of not possessing any chart which has a single fixed station point along the shore between Amherst and Half-way Creek, a distance of 15 miles. He is a young man without any scientific training, but, when an accurate chart of the river is furnished to him, he will be equal to all that is required of him.

For the above reasons, I suggest that Lieutenant Jarrad, R. N., with the *Clyde* should commence next season's work at Amherst, and that Mr. Law, the River Surveyor, should be instructed to place himself and buoy vessel at the disposal of Lieutenant Jarrad in the months of November and December, with the view of expediting the survey and of Mr. Law's obtaining a little practical experience of accurate surveying and of the method of sectionally sounding a river's bed; he will afterwards be more valuable to the public service, and available to test any changes in the sand banks both at Rangoon and Moulmein river entrances.

The proposal to resurvey the port of Amherst and its approaches will appear in a few days in my annual programme of work. I would suggest that the Chief Commissioner of British Burmah be requested to issue instructions to the Master Attendant of Rangoon to construct at once two teak-wood tripods or square beacons of open work (such as have been erected along the Rangoon river banks) for the purpose of being placed as permanent marks along the eastern shore of the Moulmein river between Amherst and Half-way Creek, at two prominent points which I have already indicated to Mr. Dodd, the Master Attendant of Moulmein. The absence of any natural clearly defined marks along that shore is a great drawback which this suggestion is intended to remove. If these beacons are in position by October next, they will greatly expedite Lieutenant Jarrad's survey of Amherst.

Tavoy was the next place inspected by me on 17th and 18th April. It appears that the first survey of Tavoy Head and the lower half of the Tavoy river, executed by Robert Moresby in 1824, was superseded, four years later, by another purporting to be by Commissioner Maingy, whilst Moresby's upper half of the river to the town of Tavoy was still retained on the Admiralty chart. This Admiralty chart of that river is dangerously erroneous. To assign their proper positions to Tavoy Head and Reef Island (the southernmost island within the

river) so as to make them stand in correct relation to the Islands and river shore-line further up, the Head must be cut off about $\frac{1}{2}$ of a mile and the Reef Island pushed westward more than $\frac{1}{2}$ a mile. The delineation of this chart is attractive to the eye, and so induces one to imagine it something better than a mere sketch, a delusion which vanishes when a surveyor's test is applied.

The British India Steam Navigation Company's steamer *Mahratta* struck on a rock to the south-east of Round Hill in Tavoy river. The rock has now been buoyed by that Company, and I have fixed its place on the chart. Strange to say, there is an anchor delineated within two cables of the rock's position, denoting that good anchorage existed there.

I am happy to say that subsequently to the *Mahratta*'s accident there has turned up a copy of that other survey of Tavoy executed in 1824 by Lieutenant (afterwards Captain) Robert Moresby, of the Bombay Marine, and published by Horsburgh, Hydrographer to the East India Company, in 1827. This chart, although evidently the result of a rapid survey, is far superior to that issued by the Admiralty, and with a little correction and addition should supersede that dangerously erroneous one. The Superintendent of our Drawing Branch will soon be able to get out a fresh issue of amended charts of Tavoy, Mergui, Pakchan, &c. Notices of the *Mahratta* rock and other dangers will also be issued.

Mergui was the next port visited on the 19th April, and again on return voyage on 10th May. Complaints had reached us at Calcutta that the water there was shoaler than shewn on the Admiralty chart, but my examination by sounding sectionally across the harbour shows this place to be much the same as in 1839. The bar is apparently broader and perhaps one foot shallower generally; but if a vessel waits till half-flood to depart or enter, she will get more than 3 fathoms always and in dead smooth water. The beacons might be rather better structures. The east beacon remains in exactly the position assigned to it by Lieutenants J. A. Young and W. Fell, I. N. The west beacon has been moved 3 cables more to south-west. I would suggest that the Moulmein River Surveyor be sent to Mergui to sound the space between the beacons and the bar *proper* (which is a little way inside of them), and with instructions to place the west beacon in the most advantageous position, reporting to me the result and giving some new directions for entering this port. I was in hopes of being able to examine the bar on my return visit on 10th May, but the monsoon had burst on the 8th, and incessant rain prevented my ascertaining anything more than the rise and fall of tide two days after full moon. A corrected chart of Mergui will soon be sent to the Hydrographer.

Passage from Mergui to Pakchan.—Although the Bengal Marine steam vessels have been navigating these waters since the survey of the Archipelago which terminated in 1839, we possess to this day not a scrap of sailing directions for these intricate channels which are in many parts so insufficiently sounded. The only remarks as to dangers and changes that reach the Government of India are such practically useless reports* as that of Mr. Wells of the *Tenasserim* concerning the extension of the Baragua Flat. I myself skirted the flat in the steamer *Mahratta* in October last, and since then Lieutenant Jarrad in the *Clyde* has carefully tested it during last season's cruise, finding as a result that the extension of the shoal is so slight as not to be a source of danger. A little information is perhaps transmitted orally from commander to commander. Those of the British India Steam Navigation Company are the chief mediums of reliable information, and I am highly indebted to Captain Pollock and Mr. Macaulay, Chief Officer of the Steamer *Madras*, for pointing out the various routes their steamers take, and for helping me in taking soundings with bearings and angles whilst navigating that Archipelago.

I shall issue sailing directions in the form of Hydrographic Notices, (as per instructions in paragraphs 9 and 10 of Government resolution of 25th October), explanatory of the normal trading route between Moulmein and Pakchan, touching at Tavoy and Mergui, and with some useful remarks on the extended voyage along the Siam Coast to Penang. In the fine season, this navigation is comparatively easy, so long as you keep in the beaten track. But in bad weather, if necessity compels a vessel to navigate side channels where the soundings are few, much danger is incurred. I have been able to add considerably to the number of soundings, have ascertained the approximate height of many of the islands, and have found one small sandy shoal off Boyce Hill inshore of the Gregorys. I have inserted Captain Pollock's rock between the Loughborough Islands, obtained good entering marks for Pakchan river, made corrections and additions to the soundings thereabouts, whilst several islands wrongly placed have been put in their correct relative positions.

Siam Coast.—Below Pakchan, I am able to show the anchorage off Rehnoung, have made a sketch showing the soundings in the south entrance to Kopah river and a less detailed one of the north entrance. Kopah has great tin mines like most of these ports along the Siam coast, but no trace of such a fine river is depicted on the Admiralty chart, indeed a range of lofty mountains occupies the very place. The survey by Captains Daniel Ross and R. Lloyd, I. N., stopped short a little above Kopah. The contour of the coast has been now slightly corrected below Kopah, and soundings added.

* The following are Mr. Wells' remarks:—"I may here remark that I feel certain, from careful observation, the Baragua Flat is extending considerably to the southward of the position marked on the chart. I have made forty-five voyages from the Madras Coast to British Burma, and having always skirted the Baragua Flat, I have perhaps had opportunities of judging that may give weight to this remark. I beg to observe it has been my practice in rounding the Baragua to define the ship's position by taking a departure from the Alguada reef light *awash*, bearing north (magnetic), and from that position steering a magnetic course E. $\frac{1}{2}$ N., when the water she should round the Baragua in, ought not, according to chart, to be less than 7 fathoms, it will be found 4 fathoms only exist. Although I am aware this may be the result of indraught, sometimes with flood tides and currents, the result of prevailing winds, I have found it so many times the same, and under so many different circumstances, such as N. E. winds prevailing, that I am firmly convinced the shoal is extending to the southward as marked by me on the chart."

Junkseylon or Salang Island.—Of this, I have obtained a pretty good survey from Captain Richelieu, Commanding the Siamese Royal gunboat *Coronation*. This officer was most obliging and communicative; he was trained in the British Royal Navy, is a good observer, active, intelligent, and most energetic in surveying the coast and islands. He has promised me tracings of his surveys to east and south-east of Junkseylon. It is strange that the town of Tonkah and Puket harbour on the east side of the island, whence 150,000 pikals of tin are annually exported, are not shown on any British chart. Junkseylon is out in latitude, whilst Pulo Rajah is on a wrong bearing (by fully 2 points) from the Brothers Islands which lie only 7 miles from the Rajah. The actual survey of Junkseylon differs immensely from what is depicted on Admiralty charts. The publication of all these corrected charts will be a great boon to the British India Steam Navigation Company.

For the islands and hills between Junkseylon and Penang, I have corrections to make on the navigating charts, and hope soon to be in possession of more notes from Captain Richelieu, who obligingly lent me his journal, from which I have already copied many remarks, with an account of winds and weather at Junkseylon for the entire year, and further notes about 2 or 3 tin ports on the adjacent coast.

I can assure the Government of India that this has been a most fruitful cruise, as I hope to show when all the charts are corrected by my acquired information. On a cruise of two months amongst the islands of the Mergui Archipelago in a small steamer I should be able so to supplement the excellent charts of Captains Ross and Lloyd with soundings, &c., as to leave nothing more to be desired in those parts for many years to come.

The naturalist attached to the Survey Department would in those two months make a good collection of the fauna and flora. The islands are densely wooded, and doubtless some of that wood might be turned to good account. I have obtained good specimens of lead ore from Maingy Island, about 22 miles west of Mergui. There would indeed be an excellent opportunity for a geologist to add to our knowledge of those islands. I shall bring this subject before the Government of India in my programme of next season's work to be submitted before 1st July.

B.

Preliminary report upon the harbour of False Point, submitted to the Government of India after inspection by the Superintendent of Marine Surveys, No. 612, dated Calcutta, 11th August 1876.

PARA 1. * * * * *

2. I am now in a position to report, after enquiry amongst practical men whose diverse interests are likely to shew up the port improvement question in its various aspects, how I consider the sum of Rs. 30,000, which can be made available now, can be best spent in the interests of the port. In doing this I am compelled, in fairness to a young and rising port, to point out that the work of erecting certain buildings, raising the low swampy ground, making roads, drains, wells, and plantations at Jumboo location, cannot fairly be reckoned among port improvements, whilst there are other things which the port really requires and should be able to enjoy out of the loan in question, the interest of which will have to be paid by port-dues alone.

3. Dowdeswell Island is most decidedly, at present, and will be for several years to come, the place for the establishments of the Master Attendant and Collector of Customs. The correspondence concerning this port does not (I must say) clearly define the locality, but beneath the surface one can perceive that as Plowden's Island, originally selected for locating the above establishments, had to give way to Jumboo, so now Jumboo is giving way to Dowdeswell, or rather let me call it by its proper name Hookytollah, for indeed all the sandy land which lies to the northward of Plowden's Island, and now at random called Dowdeswell, was occupied by the sea in Captain Lloyd's time (40 years ago) when he handed down the latter name on our charts. I recommend that the extreme North point, which advances every rainy season in a northerly direction upon the sea, should always be called False Point. A better name could not be given to a piece of land which is annually shifting its position.

4. The abortive attempt to make a settlement on Plowden's Island (or rather swamp) cost the province Rs. 10,000. It might have been predicted that this island would prove the unhealthy place it turned out to be. Fever amongst the workmen put a stop to building operations there; perhaps, fortunately, as it prevented the waste of more State money in an out-of-the-way and ill selected situation. The present sparse population existing on the Jumboo site are now fever-stricken and the residing engineer proposes to forsake the location temporarily. That this site also should be unhealthy cannot be matter of wonder when it is considered that an extensive undrained swamp bounds it on the south, the east and the north. Mr. Robertson, the Harbour Engineer, had evidently been made acquainted with this fact when he wrote of Jumboo: "The site is certainly not a healthy one, but it will become more and more so in time, as the jungle is gradually cleared and the swampy places filled up with sand of which there is abundance in the ridges beyond Temple Tree. For some years the officials connected with False Point must live away from Jumboo Island." I quote these remarks lest there be found amongst engineers any lingering desire to include Jumboo location amongst the requirements of the port. In a further report, with maps, I shall endeavour to shew the position which Jumboo occupies with respect to False Point port.

5. Statement B, accompanying Government of Bengal letter No. 1628 (Marine), dated 7th June 1876, puts down Rs. 5,000 for Harbour Master's house with Rs. 3,000 for houses and office of the Customs officers. Now, whether these necessary buildings be erected at Hookytollah or at Jumboo, their sites will require to be raised to keep them above floods and tidal waves. The irrigation inspection bungalow at Jumboo, a small building, has cost Rs. 8,000 with the incidental expenses of a deep foundation and of raising the surrounding ground. If Rs. 3,000 out of the Rs. 5,000, the 9th item of statement B, for the purpose of "filling up swamps and hollows," be allotted to Hookytollah, that sum will ensure the proper elevation of the buildings besides filling many hollows and otherwise vastly improving this settlement which is most conveniently situated with regard to the shipping. This item will be found in appendix.

6. The jetty at Hookytollah and the revetment of the foreshore (supposing that the harbour-facing shore is thereby meant, and not the eastern side of the point) are necessary and most useful works and deserve the Rs. 2,300 allotted to them. Mr. Harris, the Conservator, has already done much good by protecting the sandhill shore of Hookytollah fronting the harbour which is subject to great erosion by high tides with fresh south-west winds. This useful work has been effected with ballast landed from the shipping, and by the manual labour of his boats' crews alone. The revetment of the whole harbour-facing shore of False Point is a desideratum so as to secure a dry foot-path to Hookytollah from the extreme sandy point whereby communication would be secured to messengers from the shipping during the prevalence of strong southerly and south-west winds, when with an ebb-tide no rowing boat could make headway. I think another Rs. 1,000 might be allotted to this useful undertaking. It will require a well-built culvert to drain the swamp just to the south of Reddie Point. Allowing the high tide to flow in and out over a swamp is a measure far more conducive to the health of the neighbouring population than to cut it off from the harbour absolutely.

7. The boat creek, I am informed by Mr. Harris, will again silt up if dredged; he has tried to deepen it but without success; with fresh south-west winds the silt returned. But yet the small sum of Rs. 300, set down for improving boat creek, may be usefully expended in doing something for the protection of the life-boat and post-boat which are kept here. The item of Rs. 1,000 for plantations, which would probably include more wells and paths about the settlement, is an important and useful one.

8. Thus far I have explained how, in my opinion, Rs. 15,600 (the amount of the previously noted items) can be well spent at Hookytollah. But other necessities of False Point harbour call for the expenditure of some of the remaining Rs. 9,300 of statement B, although the proposed works for Jumboo location are repudiated by me, because being, not purely or, indeed, in any sense, harbour *improvements*.

9. It has been proposed to place a small light at the extreme point on a wooden structure capable of being moved every year or so, and thus, always unmistakably to mark the point for the benefit of vessels entering the harbour. In this proposal I fully concur, and, as this will be essentially a port light, its original cost and charges of maintenance should be borne by the Port funds. The estimated cost is Rs. 1,882-8-7 (say Rs. 1,900), and this I put down in my statement (see appendix) reducing thereby the balance to Rs. 7,400.

10. A fuel dépôt is required at Hookytollah. I would also point out that a very real requirement at False Point is a small steamer. Famine steamer No. 6 (here called the Milla Nay), having been brought down by Sir Richard Temple for his tour in the province at the close of 1874, was by His Honour lent to the Commissioner of Orissa for a year and proved of great assistance not only at False Point but at Balasore and other Orissa ports. A fresh survey of False Point harbour was made in her by Mr. Harris; the buoys of Dhumrah river were laid down; then the buoys of Balasore river. She was too soon recalled to Calcutta, and the Marine authorities would not restore her to Orissa, though they offered to send another similar steamer but without accommodation. Now, I am of opinion that such a vessel would be invaluable to the Conservator of Orissa Ports and occasionally to the Commissioner to go on tours in a deltaic province where there are no roads.

11. The Government of India may be informed of the great difficulty, and even danger, incurred by the Harbour Master or Customs Officers' *row boats* in boarding the weekly British India Steam Navigation Company's steamer as she anchors off the Point. When a spring ebb-tide is on, or a monsoon fresh is down, the stream there is like a mill race, and if a row-boat misses the vessel she cannot find shelter short of the Dhumrah river and may be totally lost. A steamer is the remedy for this. I would therefore assign Rs. 2,000 for fitting up such a steamer with the necessary accommodation and with stores for a year or two. The cost of maintenance will be about Rs. 3,000 annually (see appendix A), of which only two-fifths, or Rs. 1,200, should be debited to False Point. Rupees 4,000 I would put down for the purchase of buoys and ground tackle for mooring them; their annual repairs could then be easily met by the Port dues.

12. I have thus shewn how Rs. 23,500 may be most usefully expended upon the harbour proper. Other requirements, not now foreseen, may arise as the proposed operations make progress. The above is only three-fourths of the entire loan proposed; but, as permission is asked to draw the amount of the loan in such instalments as may be necessary, it seems to me safer to postpone consideration of any further works and to let time shew what the next real requirement may be.

13. I most strongly deprecate any attempt by means of small groynes to check the northward progress of the sand-point. I shall explain my opinion on this point more fully in my

next report with maps. No human effort, even were all the Customs revenue and Port dues annually placed at the disposal of the cleverest engineer, would avail to keep False Point from its steady growth. Better that the thoughts of the engineers should move on in company with Nature, which, by her present process, will always (at least for a generation to come) provide the same deep water as now, behind and beyond the point.

14. I also deprecate the spending of Port funds upon Jumboo location. Without going the length of urging (as Mr. Walker, C.E., does at page 31 of the correspondence) "the amalgamation of the harbour works entirely with the irrigation works, on the ground that the Jumboo channel and the harbour beyond are virtually a prolongation and integral part of the Kendraparab canal," I certainly would leave the Irrigation Department to execute all works which affect the continuity of their navigation channels connecting the interior of the province with False Point—

Firstly.—From Cuttack to False Point harbour by the central routes.

Secondly.—From Chandbally to False Point, or the northern routes.

Thirdly.—From Poorie to False Point by the southern routes.

15. The harbour improvements proper should be confined to Dowdeswell Island and the deep water area of the harbour, and for this most important undertaking I have no doubt the proposed loan of Rs. 30,000 will suffice for at least three years, whilst the interest thereon and the annual cost of the establishment will be ensured by the Port dues, even should they amount to no more than Rs. 10,000. But, as False Point port becomes better known and the navigable channels leading thereto are more nearly completed, we may expect a great increase in the number of small vessels frequenting it. But I deem it my duty here to state plainly that there never will be room for anything like the number for which Mr. J. P. H. Walker (see paragraph 2 of his letter No. 288, dated 24th January 1871) estimates there would be ample accommodation. In fact, if we even take the square roots of his figures, the numbers will only represent about as many vessels as the port will safely hold.

CUTTACK PORT FUND. FALSE POINT.

Statement A (amended), shewing expenditure on establishment of False Point Port.

PARTICULARS.				Monthly.	Annually.
				Rs. A. P.	Rs. A. P.
PROPOSED ESTABLISHMENT	...	...	...	547 0 0	6,584 0 0
Steamer (being two-fifths of total expenses of steamer).					
Full Establishment.			Salaries. Rs.		
Sub-Engineer	...	...	50		
Stoker	...	...	15		
Coal Trimmer	...	...	10		
Cook	...	...	10		
Sweeper	...	...	10		
Fuel	...	...	100		
Stores and contingencies	...	...	55		
TOTAL EXPENSE	...	...	250 Two-fifths—	100 0 0	1,200 0 0
Stores, oil, &c., for Port light	...	...		15 0 0	180 0 0
				662 0 0	7,944 0 0
Annual Port dues	...	...	
Deduct annual cost of proposed establishment	...	...		...	10,000 0 0
				...	7,944 0 0
BALANCE	...	...			2,056 0 0

CUTTACK PORT FUND. FALSE POINT.

Statement B (amended). Requirements for improvement of Port.

	Rs.
Harbour Master's house	5,000
Customs Officers' „ „	1,500
„ Office	1,500
Filling swamp and hollows	3,000
Jetty at Hookytolla	1,000
Revetment of foreshore and road to Reddie Point	1,800
Extension to extreme sandy point	1,000
Improving boat creek	300
Plantations, wells, roads, &c.	1,000
Port light, mast and house	1,900
Fitting up steamer and for stores	2,000
Purchasing buoys and moorings	4,000
TOTAL	23,500

C.

Second Report on the Harbour at False Point, Cuttack, after inspection in August 1876, by the Superintendent of Marine Surveys, dated 11th August 1877.

I APPEND two charts and a map illustrative of this report*—

First.—Coloured Chart A of False Point, showing by comparison the changes of coast line between 1835 and 1875.

Second.—A portion of the Indian Atlas-map of Cuttack sea-board, coloured, and marked B.

Third.—Chart C of False Point by Mr. Harris, the Conservator.

2. When erroneous notions are entertained as to the operations of nature at deltaic harbours, such as those of Coringa and False Point, it cannot be matter of surprise that questionable measures are sometimes suggested for their improvement. Dr. Hunter visited Orissa and wrote a book upon it which contains a vast deal of information concerning the history of this deltaic province, most valuable to future surveyors and harbour engineers. But his ideas (probably gathered from landsmen) of the manner of formation of the sea-port of Cuttack are erroneous. At page 74 of volume 1st, he says:—"The sand islands of False Point have enabled the Mahanuddy to *scour out* a harbour, destined, I firmly believe, to be one of the great future ports of India." I hope to make it clear further on (paragraphs 6 to 9) that the Mahanuddy is guiltless of such *scouring out*. Again, the Superintending Engineer, on 24th January 1871, writes of False Point harbour,—"It has, however, two serious disadvantages. The first is its distance from any extensive centre of trade, and secondly, the natural badness of its bar, which is said to be nearly dry at low water during the dry months." There is in reality no bar to this harbour. Afterwards in 1874, the Superintending Engineer of Orissa Circle asks for Rs. 2,06,800 for "work of improvement to False Point harbour, including dredging operations for three years." How puzzled must be those who have to read through the correspondence on the subject of this place without the aid of maps. The fact is that this is in no sense a bar harbour that requires dredging. But it is a most valuable and safe port for small vessels, and the key of Orissa.

3. I was fortunate enough to find in the possession of Mr. Harris, the Conservator of Orissa, an original survey of this place by Captain Richard Lloyd, I. N., with Lieutenant Montrou as his assistant, done in 1835. The contour of his sandy points and islands, with the 2, 3 and 5 fathom lines, are shown *yellow* on the accompanying chart A. Those by Lieutenant Hammond, done last year in the *Constance*, are in *red*, whilst the *blue* colours show the state of matters at an intermediate era, *viz.*, 1858. The engraved sheet itself, on which these coloured lines are drawn, is by Mr. Harris in 1868. Thus we have the state of this harbour at four epochs for comparison. A manifest difference in the bearings and the measurement of distances on these several surveys detracts in some measure from the value of these charts for scientific comparison; but in all essentials they agree, and the tendency of the point towards elongation is by them very clearly shown. The northward advance of the point is at the average rate of 80 yards annually.

4. *Dowdeswell Island*.—The breadth of the sand in the east and west direction at Hookytollah is now (*see red lines*) three-fourths of a mile. There is reason to believe, therefore, that the vicinity of what is marked as Reddie Point will also gradually widen itself. Blowing the dry surface sand along, the winds are active agents in effecting this widening process. By a judicious use of hurdles and boughs of trees to intercept the sand, the south-west winds might thus be cheaply enlisted in the good work of filling up hollows. The population of Hookytollah might be periodically utilised for this work, and much "filling up" could be effected for a trifling outlay. The north-east winds at False Point blow for scarcely one-fourth of the year, yet even they could be trained to effect some little good. At that season a breach is made in the long sandy shore of the so-called Dowdeswell Island, on a south-east bearing from Plowden's Island, but in the south-west monsoon that breach is again closed. To define the limits of the island is therefore impossible, and I think it far better to call this long strip of sand *False Point*, whilst Hookytollah is the name of the Customs-Officers' and Harbour-Masters' location. It is satisfactory to find that year after year the breadth of the Hookytollah sandy land increases; and it may be predicted that, as the swamps get obliterated by the hollows being filled up, this place will become very healthy, in fact, our *Cuttack-super-mare*.

5. *Deep Water Contours*.—The 5-fathom line of 40 years ago agrees exactly with that off the port entrance taken in the early part of this year (1876), showing beautifully that we may expect no appreciative silting in that deep water. The three and two fathom lines tell their own tale, that little comparative silting takes place under lee of the point; but that the Jumboo and Barkood rivers bring down a little sand and plenty of mud and thereby render the water considerably shoaler to the west and north-west of the anchorage. However, there cannot be a doubt that, as False Point grows in a northerly direction, these streams will be less able to transport the mud they bring down in a north-east direction throughout a longer course, and consequently we shall have a broader space of deep water behind False Point. But, on the other hand, the bunding of the Jumboo (as explained in paragraph 15) will cause the sandy point to approach nearer to the main shore-line.

6. The yellow contours on chart A show how very little of a deep water bay there was in Captain Lloyd's time. But the excellent little harbour that now exists is in no wise due to

* Not reproduced here, but furnished with the original report.

scouring. Nature has been her own engineer, and has methodically carried out the north extreme of Dowdeswell Island, like a huge groyne, into deep water, thus securing good depths with soft bottom to leeward of it. Far from any scouring by the Mahanuddy having taken place, there has actually been a little silting, but very little, and not enough to give cause for any anxiety. Then, as to "the natural badness of its bar" being stated by the Superintending Engineer as a serious disadvantage under which False Point harbour labours, it is only necessary to glance at Mr. Harris' chart to be convinced there is no bar at all; evidently, the allusion was intended to apply to the Jumboo or Barkood bars; but even of these Mr. Robertson rightly says, "The so-called bars at both places are more properly shoals; and *not bars proper* which are caused by the action of the surf in striving to reform the coast-line."

7. From the position in the upper harbour, abreast of Hookytollah, where the *Ghasipore* flat or receiving hulk is moored, and where the *Koel* steamer usually anchored when I was inspecting False Point, one can observe the marked difference of colour in the ebbing river water and the harbour water; there is a clearly defined demarcating line between the still bay water and that coming out from the Barkood and Jumboo creeks. These last are charged with silt, whilst the water of the harbour is comparatively clear. It is obvious that the principal silting takes place from the west side towards the east, and is due to the two streams above mentioned. Corroborative evidence of this is given in the fact that the *Deva* coal-hulk has occupied her present position for four or five years; the depth of water is there much the same as at first, or about one foot less only; whilst the mud flats extending off the Jumboo mouth and Temple Tree Point are gradually advancing eastward with a natural slope like an earthwork; and in two more seasons, or perhaps sooner, this operation of nature will necessitate the *Deva* coal-hulk being shifted more towards Hookytollah to prevent her taking the ground.

8. *Formation of the Harbour.*—All the black sand that is carried out of the Mahanuddy mouths and not taken out to sea by the current, is rolled up the coast by the southerly monsoon swell with the fine white coast sand, and must be deposited off Reddie Point. Not a particle (so to speak) goes beyond the Point; there it is dropped whilst a good deal of the muddy matter of the Mahanuddy, being more transportable, is held in suspension by the agitated sea, and is carried to the westward of the point, where it is deposited in conjunction with the mud of the Barkood and Jumboo rivers. All the deposit that has of late years occurred between the extreme red point (on chart) and Temple Tree Point, is not due to the Jumboo and Barkood only, but to those rivers and their parent stream, the Mahanuddy, combined. Besides the deposits in False Point bay which are thrown there by these minor streams, the freshets of the Mahanuddy in July and August, must have been the means of carrying to sea (whilst the ocean current, concurrently with the stream of flood advancing towards the Hooghly, passed along the sea bed to the north-east) those peculiar deposits of black and red specks that cover the Pilot's Ridge.

9. *Engraved map from Cuttack to the Sea.*—The blue curved lines on the engraved map B indicate the southerly monsoon swell, which lasts fully 7 months of the year, February to August inclusive. The agitated sea is nature's tilt-wagon; it keeps the sand and mud disgorged by the Mahanuddy in suspension till it reaches False Point, round which even a 3-knot flood-stream cannot carry the sand, and therefore the sea drops it there, thus making the point to grow. A little erosion of the point occurs during the north-east monsoon; the outer sand being washed inward to the south-west face of the point. This engraved map is rather old (1841). On it I have marked in blue the more modern courses of the rivers Noona and Jumboo; these indicate either that the old examination was very cursory, or that great changes have occurred in the courses of these rivers throughout several years.

10. Comparison of the old with new maps reveals deltaic secrets which make one rather tremble for some of the expensive channels for navigation projected and partly carried out in this province. The correspondence exhibits one Engineer differing in opinion wholly from another as regards the want of the province. One advises the utilisation and cheap improvement of the natural streams; whilst another would have nothing but costly artificial waterways, navigation canals, which can never by themselves yield any return. Mr. Walker, the Superintending Engineer, says, "There is no necessity whatever for a coast canal. Colonel Haig's estimate for a coast canal is taken at Rs. 60,000 per mile, whereas at an outlay of Rs. 1,000 per mile nearly the same purpose could be subserved by simply making use of the existing creeks, which, besides, have this advantage over a canal, that they not only communicate with the interior of the country by many branch nullahs, which run well up into and tap the heart of the delta, but, by means of their side inlets, they act as large natural outfalls for getting rid of the interior drainage of the country. It is impossible that the necessary works of improvement can be met from any local funds, nor can I surmise what returns such works will fetch if carried out from loan funds." I may add that the navigation canals generally get silted up somewhere during a freshet, and this silting hinders traffic for several days till dredging clears the way; the canals are also ordinarily closed for six weeks in the year for the purpose of clearing their beds of grass and silt.

11. *The Coast Line.*—The principal feature of the Orissa coast line is the range of sand hills which I have dotted yellow. This shows a tolerably regular line from the Devi Mouth in a north-east direction towards Barkood on the Mahanuddy, past Jumboo location and onwards to Palmyras Point. The swampy land that lies eastward of the Coojung, Barkood and Jumboo sand hills may be looked upon as the Mahanuddy's reclamation during upwards of 1,000 years. The annual advance seaward of the delta is very slight. The northward advance, which ends abruptly in the narrow point which forms False Bay, has been actually

measured with an interval of 40 years, and gives us a means of gauging the centennial increase.

12. The blue pencil lines on the engraved map shew about the direction of the south-west monsoon swell; which, close along the sandy shore, seems to bring its right shoulder forward, and makes the surf beat nearly *dead on*, or perpendicular to, the shore line. Many portions of the coast from Chilka Lake to False Point have doubtless seen great changes at points where a branch of the Mahanuddy at one time emerged, but the rolling swell, aided by south-west winds, has smoothed away the inequalities and made now a tolerably regular curved outline. A proper survey of the Orissa coast, which (it is hoped) may be undertaken in two or three years, will doubtless shew us many off-lying banks. The Devi river mouth appears now to be travelling up to the northward, and there is probably a good depth of water on its bar during November, December and January; it will doubtless burst out again to the southward, just as the Mahanuddy main stream alters its mouth at intervals of about a dozen years; but without a yearly examination of the changes that must occur, this Devi entrance can never be attempted by even small coasting steamers, unless annually buoyed.

13. *Harbour Improvement.*—Having thus briefly explained some of the characteristics of this coast, I proceed to offer my opinion upon various points which effect the question of harbour improvement and the development of trade. As stated in my first report, dated 11th August 1876, I most strongly deprecate any attempts by means of small groynes to check the northward progress of the sand point which shelters the harbour. I do not share the fears of Mr. Walker, who says, “I cannot too strongly express my anxiety about the changes now at work at the northern end of Dowdeswell Island. The spit, which *if kept under control*, will always maintain False Point as a harbour second to none in India, but if allowed to extend as the tides or land freshes may direct, will ere long turn (it) into another Coojung lagoon.” A glance at the coloured chart A of False Point anchorage shews that the growth of the point for more than half a century has been in an average north direction, and that only for four or five years it has bent itself a little inward. In my opinion there are two main reasons for its taking the later inward direction which is about north-north-west.

14. The first reason is that the coast line itself bends inward above Temple Point, and therefore the growing sand point follows suit. Observe the sand-hills on the engraved map; they recede a little between the Jumboo and the Bronee mouths, then from the vicinity of the Bronee they trend away in a due north-east line. I think, then, that the point may take a north direction for three or four years, and then gradually bend north-eastwards with the line of the coast.

15. The second reason for its bending inwards is, that the bunding of the Jumboo, against which Mr. Robertson (see paragraph 25) so vehemently protested, has diminished the amount of the Mahanuddy freshet water that comes down into the bay when the southerly swell is hammering outside the point and bringing up fresh supplies of sand. The combined streams of Barkood and Jumboo were the forces which prevented the bending inward of the point, but if one-half of these forces be rendered neutral by the damming of the Jumboo, it is unreasonable to expect that the sea will not take advantage of its opponent's weakness and make the point encroach upon the harbour. As for keeping the spit under control by groynes, such a thing is easier spoken of than done; let the experience lately gained at Madras be considered as to the overwhelming power of the surf when a rubble groyne is continuously exposed to its action for several months.

16. My coloured chart A shews clearly that a marked improvement in the sheltered area of False Point harbour has taken place since 1835. In fact, it was then more like what Cocanada Bay is now; whereas the Coringa Bay of Michel Topping's day more nearly resembled the present False Point harbour. Mr. Robertson, C.E., remarked upon the diverse actions of the rivers at Godavery and False Points. But Colonel Rundall has stated that this point (Point Reddie he calls it, but the same point is meant) and Point Godavery are precisely similarly situated, “the latter having extended 9 miles to the north in 30 years.” The coloured chart shews that the growth of False Point has only been really 1·7 miles in 40 years. The latest survey of Cocanada does not shew more than half the above-stated extension of Point Godavery since Fell's survey in 1845; but 9 miles since Michel Topping's time, 1786; whilst the anchorage has been shifted northwards about 2 miles, owing to the semi-filling up of the submarine portion of the bay, as shewn by the contour lines on the chart of Cocanada. We cannot, then, say that Point Godavery and False Point are *precisely similarly situated*, because the Godavery now throws nearly all its waters into Coringa Bay, whereas the Mahanuddy entirely disgorges itself to the southward of False Point light-house. In fact, the conditions (which Colonel Arthur Cotton proposed to bring about at Coringa Bay, by damming the Godavery below Hope Island, which Mr. Robertson, the Harbour Engineer, considered a very expensive and difficult operation) now actually exist at False Point; and there seems not the remotest probability of such an inroad of silt into False Point Harbour as there is at Cocanada Bay. I therefore see no cause for anxiety.

17. *Harbour Light.*—A great desideratum at this seaport is a harbour-light at the tip of the point, capable of being easily shifted out annually to within 100 yards of the verge of the point. I understand that sanction has been given to erect a suitable wooden structure. The next want is a foot-path enabling the light-keepers, and messengers from the shipping, to communicate at all times with Hookytollah. If a new first-class lantern be put up at False Point light-house, it will immensely benefit this seaport, although primarily intended to provide a better land-fall light for the port of Calcutta.

18. The boundaries of this port are not marked out yet, although they have been published in the *Calcutta Gazette* of 15th September 1875. The printed statement is, however, vague and shews no signs of having been compiled by a nautical man; it certainly should be revised in consultation with the Conservator of the Port; in fact, the port limits are so indefinite that a crafty shipmaster might easily evade the dues by anchoring outside the limits which only exist on paper. I would not advise this small harbour's entrance being choked with mooring buoys; they will only hinder vessels getting in and out; they are enormously expensive. The limits of the deep water should be well defined by buoys, likewise the channels into the Jumboo and Barkood creeks.

19. The deep portion of this harbour, capable of accommodating medium-sized coasting steamers of the present day, is of very limited area; indeed, vessels of a draught of 20 feet cannot be said to enter the harbour at all; they merely anchor off the mouth. It is exaggeration to call False Point "by far the best harbour on the whole coast of India between the Hooghly and Bombay," and to say that "the depth of water is quite sufficient for a very large class of steamers, and there is this great advantage that the bottom is so soft that the commanders of vessels are indifferent to running aground, although they have usually no occasion to do so." It is very likely that, after a gale of wind, "lumps" of sand may be found near the harbour mouth. The S. S. *Maldah* is said to have struck on a lump in March 1875; she was drawing 20 feet of water, but found a depth of only 18 feet amidships, although she had plenty of water around. Small craft that can run well into the harbour need not fear grounding, but they must take care not to do so in the wrong place, for there are spits of sand between the river channels, although soft mud prevails generally throughout the bay.

20. *The tidal currents* at the entrance require to be studied by commanders of vessels entering this port. The flood stream, at half a mile outside and eastward of the point, sets to north; at the fairway buoy it sets north-west; whilst, midway between that buoy and the point, it sets to west-south-west, and where the small shipping anchor the tidal current of the flood sets to south-by-west. It will be readily understood, then, that careful pilotage is necessary when a vessel enters the harbour on a flood-tide.

21. *Jumboo location*.—Now I come to speak of the Jumboo location. It is felt as a great want of False Point that no village—whence supplies of live-stock and fodder, food-grain and vegetables might be obtained—exists in the vicinity of the port or within two or three days' run. The Jumboo location, when built upon, planted and inhabited, would, if subsidised, meet such a want; but I think that the charge for making a settlement at Jumboo cannot in fairness be debited to Port funds. Captain Bullock of Cuttack, an excellent authority as to the wants of False Point, says, "An inducement ought to be given to ryots to settle at or near the Jumboo, so that ships frequenting the port would be supplied with fowls, mutton, vegetables, &c. None of these articles can be got at present, unless at high rates, either from the Cuttack district, or by steamer from Calcutta."

22. Owing to the damming of the Jumboo creek and river in two or three places not far from Marsaghai, the primitive fluvial communication between Chandbally and Cuttack was interrupted (so I was informed at the time of my visit, but the fact was not personally investigated by me), and all water traffic between those two places had to pass Jumboo location. Colonel Rundall pointed out as a reason why the Jumboo route should not be abandoned, that "it is the route which is now pursued by the great proportion of the country boats." Why, then, was this route stopped by the damming process? If this be the case, of course it is a good argument in favour of establishing a village at Jumboo, but still the province should make the settlement; the allotment of Port funds to such a purpose is not appropriate.

23. Again, in my opinion, the place for a primary settlement (though the ground is much less suitable for building upon) is at the Kendrapara Canal outfall on the opposite shore of the Jumboo, where it seems there is now to be no outfall lock, because no proper foundation for such a work can be obtained. But if the terminal wall of the canal be erected there, that must be the place of transhipment of cargo by steam cranes from canal boats to sea-going boats, these latter being such as could go alongside the shipping anchored in the port. As a place of transhipment of both export produce and of imports also, the Jumboo location may yet become of great importance. A complaint against False Point port is "its distance from any extensive centre of trade," but the Jumboo location might become at least a half-way house, and, as Mr. Robertson, C.E., said, "the central outlet and inlet for the traffic of a very large portion of Orissa." The extensive sandhills at and to the northward of the site of this proposed town, and the fact of its being just abreast of the shipping and within convenient signalling distance, mark it out as the right place for a settlement.

24. In the correspondence we find noted a proposal to carry the Kendraparah Canal across the Jumboo which, I presume, means the very costly extension of the canal to the Jumboo location. Then, again, it is said that Colonel Haig proposed to carry a jetty out into the anchorage from Jumboo, which jetty, with prolongation by screw-pile pier, would cost Rs. 12,17,000. Verily Jumboo will be a costly place if such works are executed.

25. It seems to me that Mr. George Robertson, C.E., was dead against any project for damming the Jumboo. He wrote as follows in his report on False Point:—

"*Kendraparah Canal Extension*.—It has been proposed to bind the Jumboo Creek and carry the Kendraparah Canal across it. But when I find that a great part of the traffic in the canal *at present* goes down the Jumboo Creek, that that creek in floods is one of the main feeders of the Jumboo River, and that, since more water has gone down the creek, the Jumboo bar has improved, I am forced to protest against bunding off this important access to the sea; at all events, the effect

of floods upon the bar must first be accurately ascertained. So far as navigation at the outlet is concerned, it would be better to improve the tortuous nature of the Jumboo River, leaving the Barkood Creek to retain only the traffic on the south side of the Mahanuddy, which will be brought down by the Toldunda Canal."

"The proposal to bund the creek has been made, partly, I conceive, for economy, and partly from the idea that the floods do more harm than good to the Jumboo bar. This latter supposition remains to be proved by soundings taken before, during, and after the rains. My opinion at present is that the creek ought not to be closed."

"*Jumboo River.*—In the construction of the Patamoonda Canal it is proposed to bund this river. The same remarks I have made on the bunding of the Jumboo Creek apply also to this project. If the traffic of Orissa is to be concentrated at the Jumboo outlet into False Point Bay, it appears to me that the stoppage of all the flood-waters coming down the main feeders of the river is a matter for grave consideration."

26. Thus wrote Mr. Robertson in 1872 ; and yet, in spite of such an engineering caution, the Jumboo (it is rumoured) has been bunded in two or three places, as I have before remarked in paragraph 15. Whether the floods do harm or good to the Jumboo bar, they, in conjunction with those of the Barkood, make up the volume of water which tends to throw out, or (more strictly speaking,) prevents from coming more inward, that growing sandy point which forms the harbour.

27. *Conclusion.*—I think the above remarks, accompanied by the three charts, will suffice to explain my view of the state of matters at False Point. It will be convenient for reference to supplement them with the first report, dated 10th August, which (omitting the first paragraph as being only explanatory of the way in which we reached the port and of the means at our disposal) gives my opinion as to the first requirements of this young harbour.

D.

Third Report on the Harbour at False Point, Orissa, by the Superintendent of Marine Surveys, dated 14th April 1877.

THIS harbour was again inspected by me on the 1st of April 1877. The soundings were tested in the steamer *Pioneer*, belonging to the Public Works Department, which was obtained for the purpose by Mr. Harris, the Conservator of Orissa Ports, who had prepared me to find some important changes for the worse in the depth of water and nature of bottom at False Point.

2. I find that a very extensive erosion of the sandy point took place during the cyclone of 31st October last. The sand was thrown, presumably by the storm-wave, from the point in a north-west-by-north direction, on which line of bearing the dry sandy spit has grown about 100 yards since last July, whilst the shoal water extends fully a cable's length beyond. The entrance of the port is thus materially narrowed, and it is not too much to say that the harbour (for this reason and that explained in paragraph 6) has deteriorated in value about one-half.

3. This sudden deterioration of the harbour is due to an abnormal and quite unexpected cause. At Madras also a somewhat similar effect was produced by the storm-wave of the same cyclone. It came in from the eastward, hurling back the laterite rubble from the tip of the south surf bank and rolling it up the sandy beach like so many pebbles.

4. A similar operation of nature may have been the means of initiating the inward bending of the spit at False Point a few years ago; but I am still of opinion that the damming of the Jumboo river has lately had a very bad effect in allowing it to extend so much. If the same stream power now exists during the monsoon freshets, as formerly was represented by the combined forces of the Bakood and Jumboo rivers previous to the damming of the latter, we might expect some favourable cutting away of the sandy spit in the approaching southerly monsoon. The amount of change should be tested again at the end of August after five months of southerly wind and swell.

5. It is stated at False Point that the *Deva* brig, which has been anchored for four or five years nearly one mile to north-west of Hookytollah, and which formerly used to swing to the ebb and flood streams of Jumboo river, now swings to the tides of the light-house creek. This statement, if correct, would tend to show that the damming of the Jumboo has had a deleterious effect upon the harbour, and jeopardises this useful little port.

6. Where formerly there was nothing but soft mud, a sandy coating is now found on the bottom, a little within the harbour entrance, which renders it dangerous to take a moderate-sized vessel any distance inward. Apparently the storm-wave would be the cause of this; but there are rumours at False Point that ballast has been thrown overboard within the harbour. Severe penalties should be inflicted upon any parties guilty of such a grave offence.

7. On the other hand, the effect of the extension of the sandy spit has been, to help the tides to scour out a deeper channel near the spit buoy, as indicated by the red soundings on the chart which accompanies this report. It will be observed, that the general depths of water near the harbour entrance have much increased; yet my previous remarks in paragraph 19 of my report on False Point harbour, dated 4th November 1876, still hold good, that "vessels of a draught of 20 feet cannot be said to enter the harbour at all; they merely anchor off the mouth."

8. The larger class of vessels now frequenting this port—and there has been a brisk trade in rice this year—have to anchor outside near the fair-way buoy. In this position the rush of tide and the monsoon swell render it positively dangerous (as stated in my preliminary report on False Point, dated 11th August 1876) for row boats to board vessels; large cargo boats without steam power are also liable to be carried away to the north by the strength of the

flood stream and ocean current combined. During last monsoon one of these craft got adrift and was picked up at Culpee in the river Hooghly.

9. I therefore deem it my duty to again call the attention of Government to the necessity (in the interest of the safety of life) of having a small steamer to carry out the ordinary boat duties attached to the office of Customs Collector and Harbour Master at this port. At times it is really unsafe for row boats to board the weekly British Indian Steam Navigation Company's steamers. Nothing but steam power will meet the emergency at False Point, but without such assistance the Conservator cannot fairly be held responsible for the safety of such cargo boats as have to go out to load and unload a vessel near the fair-way buoy.

10. The fair-way buoy now occupies one of the best positions for a large steamer to anchor at; it is therefore desirable that the buoy be moved further northward, to allow more space for large vessels visiting the port. Some vessels now anchor outside the buoy, and thus the difficulties and dangers of loading and discharging are increased and cargo boats run more risk unless a small steam tug be attached to False Point.

11. I was much astonished to find that the port-light proposed for the tip of the shifting point of sand is not yet ready, nor, indeed, are there any signs of preparation for its erection. It is earnestly to be hoped that this light may be exhibited before the monsoon comes on in force. Port dues are levied on vessels, whilst few facilities are afforded towards making the anchorage and the approach thereto safer—a pretty sure way of strangling a small rising port in its infancy.

12. It was brought to my notice at False Point—and I mention the circumstance in accordance with paragraph 11 of the Government Resolution of 25th October 1875, constituting the Department of Marine Surveys—that very bad oil has lately been supplied for the False Point light; thick dirty oil, which causes a great smoke, thereby dimming the reflectors and lanthorn windows and rendering the light far less bright than it should be.

E.

First Report on the Relative Merits of the Harbours of Carwar and Marmagao by the Superintendent of Marine Surveys, dated 26th March 1877.

PLANS on the same scale of the two headlands—which at Carwar and Goa respectively, afford shelter against the violence of the south-west monsoon—show a great similarity between the two. But the elevation of Carwar head is three times that of Marmagao, a circumstance which, amongst many others, tells against the former and in favour of the lower headland of Marmagao.

2. To compare the sheltered anchorage at these two ports, let us place a straight-edge along the northern face of each headland. That of Carwar lies on a west-by-north bearing. That of Marmagao has a north-west by west bearing. Again:—draw a west-south-west line, tangent to each head, to represent the mean direction of the monsoon swell. These lines show a far greater sheltered anchorage at Marmagao.

3. Still further to illustrate the superiority of Marmagao by calculating the relative sheltered deep water areas of the two places, draw a line on a north bearing from Konay Point (Carwar), and another from the bottom of Marmagao Bay, both these points being nearly equidistant from the north-west extremities of their respective capes. The triangular space thus shown on the chart of Marmagao is nearly double that of Carwar. But the chart of Marmagao shows a great additional space within the river mouth which has good depths of water, although we have not included it when making the above calculation. In short the sheltered anchorage of Marmagao is more than twice the size of Carwar.

4. In considering the relative merits of the two ports as shelter-giving anchorages, there is another feature to be considered. Taking the entrance of Carwar as extending from the north-west extreme of the head to Deoghur Island, whilst that of Marmagao lies between its north-west cape and Conkasoo Island, the breadth of each harbour mouth, through which the breaking sea of the south-west monsoon rolls in, has about the same sectional area. Nevertheless the dispersion of the swell that enters is effected very differently at the two places.

5. In the case of Marmagao the swell rolls away eastward up the river for 3 or 4 miles where the water is still tolerably deep, that is to say, only one fathom shallower than at Marmagao anchorage. Thus the swell becomes dispersed over this flat area of deep water, whilst only a small undulation rolls southward into Marmagao Bay.

6. At Carwar (it will be seen by the plan) the sandy shore trends northward at first from Konay Point, then north-westerly towards the islands. Thus the ocean swell is only partly broken against that sandy shore, whilst a great undulation rolls in a south-eastward direction into Beikul Cove and over the anchorage. I am of opinion that on this account the Bay of Carwar is rougher in the south-west monsoon than that of Marmagao. Having surveyed the port of Carwar, and having been there throughout one south-west monsoon, I know how the swell breaks into the mouth of the cove. With the object of preventing much of this swell, Mr. Abernethy, C.E., proposed a breakwater running north by east from Carwar head. Such a breakwater, 1,000 feet long, would not however render Carwar anchorage so smooth as Marmagao now is without any breakwater. Moreover, the holding ground at Marmagao is superior to that of Carwar because stiff mud prevails all over and around the anchorage in Marmagao Bay and well up the river. At Carwar inner anchorage the bottom is mixed sand and mud, whilst in Beikul Cove it is principally sand.

7. As we look further into the question, other features present themselves to the manifest disadvantage of Carwar. The loftiness of its headland and of the neighbouring high land of Godhully,—its massive formation, being all granite rock,—the precipitous slopes

which form the foreshore of the Bay and afford consequently very limited space for quays and warehouses,—the sunk rocks called Marriots, and another, at a distance of 100 to 150 yards from the headland, in the very place where, in making arrangements for wharfage, jetties should be constructed,—all these features tell dead against Carwar.

On the other hand, Marmagao Peninsula and the elevated land of the Salsette province to the eastward, as well as that of Cabo, are composed of ferruginous claystone, a material admirably adapted for building purposes, "the *Laterite*" of Buchanan. It is cut by pickaxe or hatchet in suitably sized blocks *in situ* when soft, and afterwards becomes soon hardened in the sun. The Portuguese fortifications at Aguada and Marmagao, as well as public buildings and churches, are built of laterite; all these ancient buildings attest the hardness and lasting nature of this claystone when exposed to the atmosphere for two or three centuries.

The province of Salsette is reckoned the best, the most fertile and the most populous and healthy part of the Goa territories.

Second Report on the Harbours of Carwar and Marmagao by the Superintendent of Marine Surveys, dated 14th May 1877.

HAVING again visited Carwar Bay, and having had access to all available documents connected with the several examinations of this port, I am now in a position to report that I can find no other survey of this bay besides my own which was executed in 1855. After 21 years I find no sensible decrease in the depth of water at the mouth of Beikul Cove. Where a buoy is now placed in 17½ feet reduced, my old chart shows 18 feet. Therefore, I cannot understand how Commander Fraser reported only four or five years after my survey that Beikul Cove had shoaled two feet.

2. It is true that a little shoaling has taken place between high and low-water marks, and in the very shallow water at the bottom of the cove, but this might have been expected after the levelling of the headlands on both sides of Alliguddi. But it is my opinion that if Beikul Cove were converted (as Commander Fraser suggested) into a wet dock, it is an impossibility that sand could be carried by any existing current from the beach of the new town of Konay (which is northward of the bridge) towards the mouth of the dock.

3. A current of greater force than two miles an hour would be necessary to carry sand (held in suspension by the waves) directly to westward in the teeth of the monsoon swell which rolls in. A little mud may be held in suspension by the monsoon waves and transported by such a current, but the current would carry it past the mouth of the cove without giving it time to settle down or to do any mischief. I, therefore, consider the construction of a large wet dock at Beikul Cove to be quite practicable.

4. In my first report, dated 26th March last, I have endeavoured to show that Carwar has not so good a natural harbour as Marmagao. Having now perused Commander Fraser's periodical reports drawn up during his stay at Beikul Cove throughout the entire monsoon of 1860, I find he records an opinion that the sloop *Falkland* under his command could not have ventured to beat out of the bay during at least two months of the year. Pattimar tindals do not run for shelter into Beikul whilst they are coasting northward in the north-wester season, on account of the difficulty of working out of the Bay of Carwar.

5. At Carwar the north-west winds of March, April and May send the swell well home to the Konay beach, whilst at the bottom of Marmagao Bay it is but little felt, the outside swell being broken over the rocky shoals which lie southward of Cabo Point and half-way to Marmagao Fort. On this account native boatmen have a decided preference for Marmagao Bay as a shelter-giving anchorage over that of Carwar.

6. Having more space for manœuvring, and with an ebb-tide under her lee, a sailing ship could easily work out of Marmagao Bay, tack and tack, during the south-west monsoon. But at Carwar a steam tug is indispensable. The Commander of the British India Steam Navigation Company's steamer *Goa* informs me that he had to tow out a ship which came to Carwar to load in the south-west monsoon. He charged Rs. 1,000 for the job, it being almost a case of salvage, because the ship was rather deeply laden, and at low water was actually bumping on the bottom of sand and mud in a depth of about four fathoms; her safety would have been greatly endangered by a day's delay.

7. At Marmagao a ship would load to 20 feet at a mooring buoy or an anchorage to the north-east of Marmagao Fort, where there is always a greater depth than four fathoms, and where cargo boats fully laden could easily reach the vessel at all times. But at Carwar the depth of four fathoms reduced is a long quarter of a mile on a N. W. by W. bearing from and dead to windward of the cove, so that cargo boats only half laden could scarcely get out to the shipping without steam power in the face of the wind and swell.

8. Looking at them as natural harbours, it is incumbent upon me to say that Marmagao affords much more shelter at all times than Carwar, whilst a few not costly works, such as a pier or two and roads of easy gradient to the top of the table-land where the houses of residents should be, would make Marmagao a good shipping port at once. But it is not my province to say whether there is any trade there now, or to state whether the high land of the interior can be easily reached by railway from Marmagao headland.

9. Carwar has already become a thriving town, with good roads, a travellers' bungalow, and several private and Government buildings, a jail and hospital, a screw-pile pier and a levelled foreshore. Its hills of granite* furnish the elements for the construction of extensive harbour works, docks or breakwaters.

* I regret having stated in a previous report that Carwar Hills are of trap rock.

10. But it must not be imagined that such harbour works will be inexpensive. To impound the water of such an extensive area as Beitkul Cove we shall require very strong walls and sheltered dock-gates, probably double gates. I am told that such safeguards as double gates are considered unnecessary for the Prince's Dock at Bombay. But I venture to predict that other views will be entertained there as the works make progress, and that the same precautions will be eventually adopted at Bombay as in the Liverpool and other British tidal docks which are considerably exposed to gales from seaward. Dock gates are difficult to close when there is a jobble of a sea. Flood gates opening inwards, with reverse or storm gates opening outwards, are found necessary for safety, and with a lock or basin between. Supposing that anything goes wrong with one pair of gates only, the dock may run dry or half empty, and vessels of deep draught would take the ground. Reverse gates are most useful in gales of wind and heavy swell.

11. If it be resolved to form a dock at Beitkul with gates, a break-water of some extent would be requisite, and the way of a vessel's approach with a view of entering the dock should be the subject of much careful consideration on the spot during the south-west monsoon, or indeed throughout the whole year, and the set of the tidal streams should be studied. I say this because it is my conviction that the plan at Bombay, now said to be sanctioned and in course of being carried out, of dredging a long and narrow approach channel to the Prince's Dock, right in the teeth of the southerly monsoon swell, will have to be abandoned in the long run, because it will be found exceedingly hazardous, if not almost impossible, to steam on a straight course throughout such a long and narrow channel up to the dock gates, with a flood tidal stream running partly across the channel. On the other hand, to think of docking a large vessel on the ebb-tide would be little short of madness.

12. If harbour works of minor extent be undertaken at Carwar, they might be somewhat like the red-tinted lines on the accompanying rough sketch. But I would advise that, before deciding upon the line of the groyne from Alliguddi, a thorough search be made for rocky patches, so that the entrance of the harbour may be thoroughly clear. A waterway of not less than 200 feet should be left between the break-water and Carwar Head near the Fisherman Rock, to allow the reflux current of the bay a fair egress during the south-west monsoon, thereby we should prevent any possible silting. By dredging inside the harbour any amount of deep water could be secured.

F.

*Report on the Lights at Norman's Point, Chittagong, by the Superintendent of Marine Surveys,
dated 14th February 1877.**

ACTUAL inspection of the Norman Point lights, and conversation with practical navigators well acquainted with Chittagong river and the approach thereto, have confirmed me in the views, which I have before expressed, that these lights might be easily and advantageously moved. Thus all chance would be removed of their being prostrated by the sea swell or by tidal current erosion.

2. Navigators complain that the lights, as now placed, are quite inadequate to point out where ships may anchor at night conveniently for entering between the bar-buoys in the morning. And not merely inadequate are they, but misguiding to a stranger, who might imagine (in the absence of any Notice to Mariners that *these* are not "leading lights," or from his experience of the arrangement of "lights in line" at European ports) that he could run in with a small vessel over the bar with these Norman Point lights in line. But such a course would probably lead to disaster (*see* Chart of Chittagong, marked A).

3. Under the existing system, sailing ships approaching from southward frequently overshoot the mark and find themselves to northward of the Kornafulli entrance, and within the influence of the strong Megna flood-stream which runs frequently at the rate of five miles an hour. Therefore they must bide a whole flood and must work back with the ebb to gain a position convenient for entering the channel between the buoys. Steamers also sometimes overshoot the mark and find themselves in the morning northward of the entrance.

4. These lights being then in a wrong position, there is little wisdom in expending port funds annually (Rs. 6,565 is the amount stated by the Commissioner of Chittagong to have been sunk up to the end of 1876 in protecting the outer beacon) to maintain them in such wrong position. For about Rs. 1,000 they can be moved rather more than a nautic mile to the southward to a better position, which is sheltered from the swell of the south-west monsoon, and being more projecting and more to windward at that period of the year, will render these land-marks both by day and night more advantageous to shipping.

5. Reference to Chart B will show also how inadequate is the Kootubdeah light as a "land-fall-light" for Chittagong, unless the soundings likewise are attended to. But if navigators could only be persuaded to keep the lead going, and never to deepen over seven fathoms (low-water depth) when approaching Chittagong from the westward, the Kootubdeah light would be a useful auxiliary. I am giving a separate report on the Kootubdeah light and the "land-fall" question. Attention may, however, be properly called to it in this place to illustrate these remarks concerning the existing inadequate provision made by lights and sailing directions for approaching such a very important port as Chittagong.

* The Charts referred to in this report are not reproduced here.

6. Mr. Warden, the Collector of Customs and Conservator of the Port, had already before my arrival at Chittagong examined the coast to southward, and went with Major Smyth, R.E., the Superintending Engineer, and myself to indicate what he and several Commanders of British India vessels considered the most suitable locality for these port-lights. I quite agree with their choice, and I believe Major Smyth also concurs. The spot is marked N P on both Charts A and B. It will be observed that a sandy peninsula (which is always dry at high-water, except perhaps at high spring tides in the south-west monsoon when the sea may break over it for an hour or two every day at high-water) fronts the coast thereabouts, so as to afford the requisite protection which the beacons fail to get at Norman's Point.

7. On Chart B the range of the two lights, as now proposed to be placed, is shown by a red semicircle for clear weather, and a blue one for hazy weather. From this new position they will be sooner *picked up* by the navigator coming from the southward after he loses sight of Kootubdeah light. By placing them about 45 yards apart on a bearing from the seaward direction of south-east-by-east, they will be in a line (see Chart A) when a vessel is half a mile outside the bar-buoys, and she can approach on that line into five fathoms (low-water depth) and there anchor till daybreak. On clear nights the bar-buoys may be visible through a telescope.

8. Approaching from the northward, small steamers and the numerous country craft, which in the fine season bring rice from Dacca and contiguous districts, will find these newly-arranged lights most useful to keep them clear of the Patunga flats. On moonlit and otherwise clear nights, these country boats will be guided to the vicinity of the bar-buoys, so as to sight them and advantageously sail or row into the channel of the river without fear of mishap as at present. Under the existing arrangement, if a small vessel steers for the two lights when they are in line (see paragraph 11), she will be drawn over the Patunga flats, and at low tide will be certain to take the ground.

9. If Government sanction be accorded to shifting these lights, "Notices to Mariners" could be at once issued, giving information as to their removal to a more seaward and southward position, and furnishing other useful hints about the navigation of these parts. Even if a mariner fails to get such notice and should expect to find the lights in their old positions, their transfer seaward and along a straight coast entirely precludes the possibility of his getting into danger by following the obsolete directions through ignorance.

10. I think the above remarks will suffice to show what action should at once be taken to ensure having the Norman Point beacons on their new site before the next southerly monsoon commences; but no time should be lost. The seaward or front light should be shown about 15 feet lower than the back light. At present they are too nearly on the same level. I am sanguine that, under the proposed arrangement, the port funds will not be drained to the extent of Rs. 2,000 or Rs. 3,000 annually, which is about the present expenditure to keep the sea from encroaching. Under these new conditions there may also be money to spare for making further improvements in lighting the entrance of Chittagong river, the nature of which I shall now proceed to explain with the aid of Chart A.

11. On Chart A (by Mr. Pearson, who gives the depths in fathoms) I have inserted in red the result of Lieutenant Hammond's fresh survey of the entrance channel, the soundings being in feet. The contours of the shoals and hills and the coast-line are given with an accuracy that was lacking in Mr. Pearson's work. I do not think that much change has taken place in the interval of eight years. The bar-buoys have, however, been moved outward about 1½ or 2 cables, and there is shoal water of nine and ten feet in the vicinity of the south buoy, on a spot which was evidently not traversed by Mr. Pearson. I believe this explains the fact of the British India Steam Navigation Company's steamer *Penang* taking the ground about two years ago outside the south buoy as then placed (see my report as per margin). The green

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line, S.-E.-by-E. ¼ E., drawn from the Norman's Point beacon, shows that a small boat would take the ground at the tip of Patunga flats if attempting to run into the river at night towards low-water with the present lights in line. But with the lights as proposed in paragraph 7 she could reach a good position off the bar-buoys in safety, and drop into the river with the first of the flood.

12. Further improvement in lighting the entrance could be effected by placing a small column to carry a light on a hill which is 1,400 yards on a N. ¼ W. bearing from the flagstaff by the new Public Works Department bungalow. Then another small light beneath it towards high-water mark to form "*leading lights*", as indicated on Chart A by the double red line running down the entrance channel. The lower light would, of course, be capable of being shifted if the mid-channel line shifts at all. Thus we should establish a very inexpensive but effective method of lighting the coasting steamers and the numerous small craft (belonging to Chittagong and contiguous ports) into the river, and a small light-duty might well be exacted, say, half an anna per ton.

13. The last paragraph has reference only to the improvement of the local lightage of Chittagong. Still further general advantage will accrue to the water traffic of the district if the above proposed light-house on the hill be made more lofty and substantial, raised about 50 feet above the hill top. Then at a total elevation of 150 feet and with a good lantern the light might be visible over the trees of Patunga Point and nearly all the way to Sundeep Island. A glance at Chart B will show fully the value of such a light. Sundeep Channel, after being properly surveyed, would then become a place of safe shelter in the south-west monsoon, by adding a small port-light near the south-east point of Sundeep Island.

*Report on the Kootubdeah Light, Coast of Chittagong, by the Superintendent of Marine Surveys,
dated 14th January 1877.*

HAVING now personally inspected this light-house and the neighbourhood, after two opportunities of approaching it from seaward, and having fully considered the nature of the soundings beyond the offlying banks, comparing the survey of Captain R. Lloyd, I. N., in 1838-39 with that of Mr. Pearson in 1868-69 (see Chart B, on which the later soundings and outline of coast are noted in red), I am better able to give an opinion on the general question of the navigation of the Chittagong Coast and of the reported defectiveness of the lightage thereof to which allusion has already been made.

2. The light-house at Kootubdeah is a good solid building, but the light is of the old-fashioned style, eight lamps in two rows extending over a semi-circle, with polished semi-oval reflectors; the wicks are quite exposed, having no chimneys. Cocoanut oil is burnt, which produces abundant smoke, so that the reflectors and the glass windows of the lantern house become much dimmed, and the former require cleaning, according to the light-keeper's statement, every two hours. If the cleaning operation is neglected for four hours, I believe the visibility of this light would be diminished to less than one-half its proper range. Perhaps this sometimes happens; but who can tell? The worse the quality of the oil, the more is the smoke. In my original report there was a sketch plan of the disposition of the lights which shows that not more than three reflectors can converge their rays to one point of the horizon.

3. I scarcely venture to speak of the practicability of maintaining the light-house intact against the sea-encroachment. This is a question for engineers to decide; yet I am inclined to think it may be done, if absolutely necessary. Major Smyth, R.E., the Superintending Engineer, who went with me to the light-house, has taken in hand the necessary measures to repair the protective works at Kootubdeah which suffered so much by the late storm of 31st October 1876, which was a cyclone of exceptional severity, attended by no ordinary storm-wave. I believe the wooden piling, which constituted the protection, had been injured previously by the south-west monsoon swell; and thus, having a weak point, it was not strong enough to meet the cyclone-wave, which rose at least half a yard above the highest tides.

4. I think that the wooden pile revetment may be made sufficiently strong to resist the encroachment of the sea, the action of which only lasts for two or three hours at a time in every twelve hours—that is to say, towards high water. I conceive that a sort of floating breakwater might be formed of unlopped trees chained on to an old ship's cable, which should be stretched along the sandy shore a few yards to seaward of, and parallel to, the revetment and pinned down in three or four places by screw-piles, such as lie by dozens unutilised for their original purpose in the Kidderpore Dockyard. Jungle trees, suited to the purpose, are to be found on the island. Plenty of lengths of old chain, too much worn and untrustworthy for a vessel's cable, may be found at nearly all large seaports, and would cost very little. But such an auxiliary to the protective works now about to be strengthened would be very useful. As the sand for 50 yards below the revetment would be dry during at least 12 hours out of the 24,—that is to say, for at least six hours of every tide,—the trees, if broken by exceptionally strong waves, could be renewed very easily. The chain-cable and screw-piles would be always recoverable: therefore a tolerably good cable might be employed at once, and this would cause the floating break water to be more likely a success. I strongly advise its being tried during the next south-west monsoon.

5. I say without hesitation that it is of importance to keep the Kootubdeah Light-house standing for at least five or six years. Several commanders of vessels, merchants, and others proposed an alternative light on screw-piles at the South Patch Sand, about 24 miles to south-south-west of Kootubdeah. Such a light would be generally useful; but the cost would be great—too great for the Chittagong Port Funds to bear, even if only paying the interest on the necessary borrowed money, which interest could not be less than Rs. 10,000 annually.

6. Then, again, we have no sound data to go upon as to the permanence of the South Patch Sand. Measures to test this question, and borings to ascertain whether the foundation is suitable for screw-piling, are a preliminary desideratum. The former measure can only be effected by screwing down two or three piles (bracing their heads together to secure stability) during one fine season, January or February, and then taking sections of the depths of water over and around the Patch. Repeating the sections in the following year will afford accurate information whether the sand shifts* from the violence of the continuous monsoon sea during five or six months. It would not be prudent to decide upon putting up a costly screw-pile light-house without taking the above precautions.

7. Another aspect of this Chittagong "landfall light" question has come under my consideration since my visit to Kootubdeah. After transferring Mr. Pearson's soundings, taken in 1868-69, to the old Coast Chart by Captain R. Lloyd in 1838-39, I was led to remark how deep the water is around the South Patch Sand, and, that no vessel could therefore reach that dangerous sand without passing through the deep water for many miles. I draw the waving green line on Chart B to show clearly the seven fathoms line at low-water. It is obvious that a vessel approaching the port of Chittagong from the westward must pass over the Great Megna (Ganges) flats in pilot water; that is to say, in such shoal water as will be indicated by the hand-lead kept going when the vessel is not running more than seven or eight knots an hour. On my late visit to Chittagong in the British India Steam Navigation Company's Steamer *Kurrachee*, we carried six fathoms (not varying a quarter fathom either way) for

* The recent total destruction of Krishna shoal light-house points to the necessity of such precautionary measures.—A. D. T.

upwards of three hours, or over 20 miles of the Megna flats. Afterwards the depths increased gradually to nine fathoms and more before we sighted Kootubdeah Light-house about noon-day. Attention to the soundings in this part of the Bay of Bengal is indeed all that is requisite to keep a vessel off the South Patch Sand when she approaches from the Calcutta direction. On leaving Chittagong the same precautions will enable a vessel to round the sands always in safety.

8. The following is from my "India Sailing Directory" concerning the approach to Chittagong :—

"THE BANK OF SOUNDINGS extends for fully 70 miles to the south of the Islands Sundeep and Hattia. On the outer 30 miles of this bank the depths range from five to seven fathoms; so, for distinction, we call it the Great Megna Flat, which if properly surveyed would prove an invaluable guide, a leading bank (as it has been called) for vessels bound to Chittagong, to enable them to pass up clear of those dangerous shoals, the North and South Patches."

Again, in another place :

"These banks have been called the *leading sand* to Chittagong, and a vessel may make the circuit of them by keeping in seven fathoms, hauling out to south-east or up to north, to maintain that depth."

9. Approaching Chittagong from the southward, or from the Burmah coast, steamers at all times, and sailing ships in the north-east monsoon, must trust to the soundings and be warned by deep water of their approach to the South Patch Sand. But in the south-west monsoon sailing ships should altogether avoid the Chittagong Coast below Kootubdeah, keeping well to windward of their port, and striking soundings on the Great Megna Flat, which they can then easily skirt round, as explained in the quotation of paragraph 8. The Sailing Directory cautions a ship against getting in with the coast near the White Cliffs (see Chart B) in the south-west monsoon, as with the strong flood she could not hope to weather the South Sand Patch and would have no alternative but anchoring in a heavy sea-way, and with a lee tide of four or five knots, till the ebb makes.

10. After sighting the newly-erected and admirable Oyster Reef light, a vessel bound for Chittagong should stand over to the Megna flats and strike soundings there in shallow water. This course she could adopt in the south-west monsoon. During the north-east monsoon there is little difficulty or danger if the soundings be always attended to.

11. Chart B shows what a poor account of the soundings we have off the White Cliffs, Elephant Point, and the mouth of the River Naaf. Certainly this part of the bay requires to be surveyed before a decision can be arrived at about positions for lights. These remarks, taken with those in paragraphs 5 and 6, are nearly all that need be advanced now against the propriety of deciding upon the South Patch Sand as the best place for a new light.

NOTE.—None of the charts alluded to in the above Appendices have been reproduced in this report, as they would necessarily have to be reduced and then printed in colours to convey any idea of the alterations or proposals referred to. The reproduction I found impracticable as our limited staff in the Drawing Branch would not admit of it, and the cost would have been very considerable.—A. D. T.

G.

True bearing of Double Island Light-house from Amherst Point Pagoda.

At Amherst Pagoda, true bearing of Beloo Gyoon (S.) Pagoda	...	N. 8°01'50" W.
Angle between Beloo Gyoon Pagoda and Double Island Light-house	...	176°01'00"

172°59'10"
180°

True bearing of Double Island Light-house from Amherst Point Pagoda	S. 7°00'50" E.
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Convergency so small as to be inappreciable.

To find the difference of longitude :—

mm 12:15	log. dist. =	1.0635	Cor. for Elliptl. fig.—
Sin. 7:01 (bearing)	=	9.0869	Cos ² . (15°59') — 1.965756
Sec. 15:59 (Mid. Lat.)	=	10.0171	Log. 150 2.178091
1.54	0.1875	.006161	— 8.789665
1'32"·4E.			Cor. for 1" in lat. 15°59' N. = .0061
Long. Amherst Point Pagoda	97°38'08"3E.		+
			= .0080
Long. of Double Is- land Light-house	97°34'35"7E.		.0091

Cor^a. so small not taken into account.

F. W. JARRAD, *Navigating Lieutenant, R. N.,*
Commanding I. G. S. V. "Clyde."

H.

AMHERST, MOULMEIN RIVER.

Observations at Amherst Point Flagstaff, 7th December 1876.

True bearing of Beloo Gyoon Pagoda, deduced from four sets of observations taken at equal altitudes :—N. 8°01'50".5 W.—

(1.)	8°01'58"
(2.)	02'12"
(3.)	01'51"·4
(4.)	01'25"·5
True bearing of Beloo Gyoon	07'21"·9
Pagoda from Amherst Flagstaff ...	... N. 8°01'50"·5 W.

Observations for Variation at Amherst Flagstaff, 8th December 1876.

BLOO GYOON PAGODA.

Magnetic bearing (10 obs. A card)	...	N. 5°57'16" W.
Ditto (10 obs. J card)	...	N. 5°56'38" W.
Ditto Beloo Gyoon Pagoda	...	N. 5°56'57" W.
True bearing, Beloo Gyoon Pagoda...	...	N. 8°01'50"·5 W.
Variation	...	2°55'06"·5 E.

Magnetic Variation at Amherst 2°55'06"·5 E.

F. W. JARRAD, *Navigating Lieutenant, R. N.,*
Commanding I. G. S. V. "Clyde."

APPENDIX H*.

Synopsis of the result of the observations made for determining the Meridian Distance between Amherst Point Pagoda and Diamond Island (Flagstaff) between the 12th and 16th of February 1877.

	Standard.	A.	B.	C.	D.	E.	F.	G.
	H. M. Sec.	H. M. Sec.	H. M. Sec.	H. M. Sec.	H. M. Sec.	H. M. Sec.	H. M. Sec.	H. M. Sec.
Errors of Chronometers on (M. T. F.) at Amherst Pagoda on 14th February 1877 ...	6 13 27.458 P 6 13 27.313 P	1 14 51.277 P 1 14 51.187 P	6 30 45.977 P 6 30 41.987 P	6 00 39.938 6 00 01.938	4 00 39.938 4 00 29.938	5 13 45.738 5 13 30.738	5 13 45.738 5 13 30.738	50.438 50.438
Ditto ditto	...	...	...	...	...	...	...	68.8138 68.8138
Four day's travelling rate ...	...	...	...	...	...	...	...	...
Daily travelling rate ...	...	...	...	...	...	...	...	...
Meridian distance from Amherst Point Pagoda to Diamond Island.	...	...	...	...	...	...	...	...
Errors at Amherst Pagoda on 14th February 1877	6 13 28.737 P 6 13 28.664	1 14 41.187 P 1 14 41.194	6 30 41.987 P 6 30 41.994	6 00 01.938 6 00 19.938	4 00 39.938 4 00 19.938	5 13 30.738 5 13 30.738	5 13 30.738 5 13 30.738	1 47 68.8138 1 47 68.8138
Two days' travelling rate ...	...	...	...	...	...	...	...	...
Errors on 14th February (rought up)	6 13 28.367 6 13 28.360	1 14 37.281 1 14 36.901	5 30 45.831 5 30 45.891	6 00 30.367 6 00 31.991	4 0 16.369 4 0 47.809	5 13 08.019 5 13 58.809	5 13 08.019 5 13 58.809	1 47 487.10 1 47 34.209
Ditto 14th ditto Diamond Island	...	...	...	...	...	...	...	...
Meridian distance ...	...	...	...	...	...	...	...	...
Meridian distance from Diamond Island to Amherst Point Pagoda.	...	...	...	...	...	...	...	...
Errors at Diamond Island (Flagstaff), 14th February 1877 ...	6 59 17.609 P 6 59 17.604	1 27 35.491 P 1 27 35.044	6 49 51.191 P 6 49 51.194	6 47 18.508 6 47 18.504	8 47 08.008 8 47 15.944	5 08 32.008 5 08 32.004	5 08 32.008 5 08 32.004	1 36 36.2008 1 36 36.2004
Two days' travelling rate ...	...	...	...	...	...	...	...	...
Errors on 16th February (rought up)	6 59 18.563 6 59 18.533	1 27 31.536 1 27 30.277	6 49 53.935 6 49 52.933	6 47 08.003 6 47 08.003	8 46 58.963 8 46 58.963	5 08 37.735 5 08 37.735	5 08 37.735 5 08 37.735	1 36 17.715 1 36 16.833
Ditto ditto at Amherst ...	...	...	...	...	...	...	...	...
Meridian distance ...	...	...	...	...	...	...	...	...
Meridian distance from Amherst Pagoda to Diamond Island.	...	...	...	...	...	...	...	...
M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.
Standard. 13 07.945	Standard. 13 07.905	Standard. 13 07.865	Standard. 13 07.825	Standard. 13 07.885	Standard. 13 07.845	Standard. 13 07.805	Standard. 13 07.765	Standard. 13 07.725
A. 08.360	B. 08.360	C. 07.849	D. 07.849	E. 08.510	F. 07.910	G. 08.610	H. 08.610	I. 08.610
Range 0.652	Range 0.652	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698
Mean meridian distance ...	13 08.058 = 3° 17' 13"'	Mean meridian distance ...	13 08.058	Mean meridian distance ...	13 08.058	Mean meridian distance ...	13 08.058	Mean meridian distance ...
AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,
22nd February 1877. } }								

xviii

Meridian distance from Diamond Island to Amherst Pagoda.	...	...	...	...	...	...	...	...
M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.	M. Sec.
Standard. 13 07.945	Standard. 13 07.905	Standard. 13 07.865	Standard. 13 07.825	Standard. 13 07.885	Standard. 13 07.845	Standard. 13 07.805	Standard. 13 07.765	Standard. 13 07.725
A. 08.360	B. 08.360	C. 07.849	D. 07.849	E. 08.510	F. 07.910	G. 08.610	H. 08.610	I. 08.610
Range 0.652	Range 0.652	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698	Mean Range 0.698
Mean meridian distance ...	13 08.058 = 3° 17' 13"'	Mean meridian distance ...	13 08.058	Mean meridian distance ...	13 08.058	Mean meridian distance ...	13 08.058	Mean meridian distance ...
AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,	13 08.058	AMHERST,
22nd February 1877. } }								

FED. W. JARRAD, Naug. Lieut., R.N.,
Dey. Supt., Marine Survey,
Comdg. I. G. S. "Clyde,"
Long. of Diamond Island flagstaff = 94 16 2 East of Greenwich.

Mean meridian distance ...

AMHERST,
22nd February 1877. } }

94 16 2

East of Greenwich.

FED. W. JARRAD, Naug. Lieut., R.N.,
Dey. Supt., Marine Survey,
Comdg. I. G. S. "Clyde,"

I.

DIAMOND POINT, CAPE NEGRAIS.

*By observations at Diamond Island Flagstaff, 14th February 1877.*True bearing of Pagoda on Pagoda Point, Cape Negrais, deduced from five sets of observations taken at equal altitudes:—N. $20^{\circ}34'07\cdot17$ W.—

(1.)	$20^{\circ}34'10\cdot85$
(2.)	$38'54\cdot20$
(3.)	$84'97\cdot20$
(4.)	$84'17\cdot00$
(5.)	$38'46\cdot60$

$$\left. \begin{array}{l} \text{True bearing of Pagoda on} \\ \text{Pagoda Point from Diamond Island Flagstaff} \end{array} \right\} N. 20^{\circ}34'07\cdot17 \text{ W.}$$

Observations for Variation at Diamond Island Flagstaff, 14th February 1877.

(Pagoda on Pagoda Point.)

Magnetic bearing (10 obs. A card)	... N. $23^{\circ}02'18\cdot$ W.
Ditto (10 obs. J card)	... N. $23^{\circ}18'12\cdot$ W.
Ditto of Pagoda ...	... N. $23^{\circ}07'45\cdot$ W.
True bearing of Pagoda ...	... N. $20^{\circ}34'07\cdot17$ W.
Variation ...	$2^{\circ}38'37\cdot88$ E.

Magnetic Variation at Diamond Island $2^{\circ}38'37\cdot88$ E.F. W. JARRAD, *Navigating Lieutenant, R. N.,*
Commanding I. G. S. V. "Clyde."

J.

KYOUK PHYOU, ARAKAN.

*Observations at Casuarina Trees, Dalhousie Point, dated 20th April 1877.*True bearing of Pagoda Rock from Dalhousie Point, N. $38^{\circ}45'36\cdot2$ W.* (deduced from five sets of observations by single altitude).*Observations for variation at Kyouk Phyou, dated 20th April 1877.*

(Pagoda Rock.)

Magnetic bearing by 10 observations A card	... N. $41^{\circ}30\cdot3$ W.
Ditto by 12 observations J card	... N. $41^{\circ}32\cdot4$ W.
	<u>2·7</u>
Mean magnetic bearing ...	... N. $41^{\circ}31\cdot3$ W.
True bearing ...	... N. $38^{\circ}45\cdot6$ W.
Variation ...	$2^{\circ}45\cdot7$ E.

Magnetic Variation at Kyouk Phyou $2^{\circ}45'42\cdot$ E.

(1.)	$38^{\circ}45'25\cdot$
(2.)	46"
(3.)	58"
(4.)	23"
(5.)	29"

$$\left. \begin{array}{l} \text{True bearing of Pagoda Rock} \\ \text{From Dalhousie Point} \end{array} \right\} ... N. 38^{\circ}45'36\cdot2 \text{ W.}$$

F. W. JARRAD, *Navigating Lieutenant, R. N.,*
Commanding I. G. S. Steamer "Clyde."

K.

Extract from the Report of SURGEON JAMES ARMSTRONG, B.A., M.B., F.L.S., &c., Surgeon and Naturalist, Marine Survey of India, being a brief summary of results for the season 1876-77, in the I. G. Surveying Steamer "Clyde."

THE correctness of the observations that were made in last year's report relative to the unsuitability of the *Clyde* for sounding or dredging purposes was demonstrated in the result of the present season's work.

2. Owing to the unsettled state of the weather which prevailed after our leaving Moulmein, and the necessity of our economizing coal, the opportunities that offered themselves for dredging were extremely limited; and as experience shewed that it was impossible to select localities, the results have all been very meagre.

3. From November to March the *Clyde* was stationed between Moulmein and Amherst. Throughout this region all those natural causes, which in tidal rivers tend to diminish in number the lower forms of animal life, exert their influence to an extreme degree, and in consequence the invertebrate fauna is here almost entirely absent.

4. Along the shore, however, and more particularly in the vicinity of Amherst and in the island of Beloo Gyoon, several interesting species of Echinoderms, Crustaceans, and Molluscs have been secured, and of these a detailed account will shortly appear.

5. During the season a fair ornithological collection was made, amongst which the following specimens which are specially deserving of notice are included, viz.—*Palco peregrinus*, *Microcerculus poliopsis*, *Butastur teesa*, *Butastur liventer*, *Pernis ptilorynchus*, *Ketupa javanensis*, *Caprimulgus macrurus*, *Caprimulgus asiaticus*, *Harpactes oreskoi*, *Merops philippinus*, *Nyctiornis Athertoni*, *Pelargopsis burmanica*, *Pelargopsis amauropelta*, *Halcyon pileata*, *Carceneutes pulchellus*, *Serilophus lunatus*, *Rhyticeros subruficollis*, *Palaeornis nipalensis*, *Loriculus vernalis*, *Yungipicus canicapillus*, *Hemicercus canente*, *Meiglyptes jugularis*, *Muelleripicus pulverulentus*, *Gecinus vittatus*, *Chrysopogon chlorolophus*, *Micropternus phaioceps*, *Heirococcys sparveroides*, *Oolygon rufiventris*, *Surniculus lugubris*, *Chrysococcyx xanthorhynchus*, *Coccystes coromandus*, *Lanius collurioides*, *Garrulax Bellangeri*, *Phyllornis chlorocephalus*, *Irene puella*, *Phylloscopus tenellipes*, *Calobates melanops*, *Corydalla Ricardi*, *Alsocomus phoeniceus*, *Turnix maculosa*, *Eurynorhynchus pygmaeus*, *Totanus Haughtoni*.

6. The occurrence of the latter species is a fact of especial interest. I have described under the name *Totanus Haughtoni* (*vide* p. xxxix) two specimens of a bird which was apparently new to Science, and which I had procured the previous season from the neighbourhood of Rangoon, but from the occurrence of only two specimens, I was unable to assert with absolute certainty the novelty of the species. Now, however, the facts elicited by a careful comparative examination of the Moulmein birds, supplemented by the evidence derived from the type specimens from Rangoon, afford conclusive proof that they must henceforth stand as a new and distinct species.

7. The rough notes made on the ornithological specimens collected during the previous season 1875-76 were elaborated in a paper which was published in Vol. IV of "Stray Feathers" * and are given *in extenso* in the following pages.

* A journal of Ornithology for India and its Dependencies. Edited by Allan Hume and published by the Central Press Company, Calcutta.

NOTES ON SOME BIRDS COLLECTED IN THE EASTERN OR RANGOON DISTRICT OF THE IRRAWADDY DELTA, 1875-76.

FROM the latter end of November until the beginning of March, my duties, as officer in medical charge of the Marine Survey of India, enabled me to devote a portion of my time to the study of the avi-fauna belonging to the Rangoon district of the Irrawaddy delta. During this period, so far as I was able, I have made short notes upon the habits of the birds collected and have carefully recorded in the flesh the different dimensions of each species met with, in the hope of being able to add something to the general store of ornithological facts.

Before giving a detailed account of the different species found to frequent this district, I shall first endeavour to convey a rough idea of the region in which they were collected.

By reference to a map of this coast it will be seen that the Rangoon river, after its junction with the Pegu, forms the eastern boundary of the Irrawaddy delta, and that at some distance to the westward a second large stream pours out its waters into the Gulf of Martaban. This stream is called the China-Ba-keer river, and has for a considerable portion of its terminal length a direction more or less parallel with the Rangoon river, with which it is connected at irregular intervals by several large channels or creeks, extremely tortuous in their course, and all mainly depending for their depth of water upon the condition of the tides.

Between the mouths of the Rangoon and China-Ba-keer rivers, is enclosed a district of about five and twenty miles in extent, of which the main feature is its perfect flatness, without the slightest hill or smallest elevation to be seen on any side. Yet notwithstanding its uniformity in this respect, it possesses a great diversity in the character and amount of its vegetation. Swamps and jheels, open waste ground and ploughed lands, forest country and thin tree jungle, are all to be met with.

Throughout this region the great majority of the collection, which forms the subject of the following notes, was made. Some few specimens were also collected from the immediate vicinity of Rangoon, and others from the region about Eastern Grove, which forms the eastern boundary of the Rangoon river near its mouth. Several birds were also obtained from the neighbourhood of Syriam, a small town and district situated near the eastern bank of the Rangoon river, close to its junction with the Pegu.

In the Syriam district alone there are a few slight hills and rising grounds, the highest attaining an elevation above the surrounding level of perhaps 150 or 180 feet. These hills are, for the most part, clothed with forest trees, consisting chiefly of various species of figs and acacias, which furnish an abundant supply of food to the numerous birds which frequent them. Several species of squirrels, too, are to be met with: *Sciurus Phayrei*, Blyth, *Sciurus ferrugineus*, Cuv., and *Sciurus chrysotus*, Blyth, all occur here in tolerable abundance.

It only remains now to say a few words upon the zoology and physical features of the country which intervenes between Elephant Point at the mouth of the Rangoon river, and the village of China-Ba-keer, similarly situated with regard to the river of the same name.

The marine zoology of this district is extremely small and scanty. The great rapidity of the tides, the brackishness of the water, and the immense amount of mud and fine sand, which is held in suspension by the water, and is constantly being deposited by subsidence on the bottom, are the factors which most powerfully co-operate to prevent the development and retard the growth of the marine fauna in this locality.

The littoral fauna, on the contrary, is abundant. Along the entire length of the coast line, between Elephant Point and China-Ba-keer, there are immense mud flats, varying from half to three or four miles in width, which at low tides are left uncovered, and swarm with different kinds of crabs and small mudfishes. These banks afford rare feeding-grounds to multitudes of Stints, Plovers, Herons, and other shore birds, which congregate upon them.

Fringing this long stretch of mud (which, by the way, is very soft, and without some special contrivance impossible to traverse) is a very gently sloping beach, varying in width from fifty to several hundred yards, and entirely composed of fine white sand. This zone of sand swarms with a crimson stalk-eyed crab, *Ocypode platytarsis*, which exists in such numbers at certain points, as to give the beach the appearance of an extended surface of crimson. As one approaches this crimson expanse, a very curious effect is produced by the sudden disappearance of the colour along the margin, caused by the instantaneous withdrawal of the crabs into the holes, which they burrow for themselves in the sand, and from which they never appear to wander for more than a few feet.

At intervals along the shore the continuity of this sandy beach is interrupted by mangrove swamps, which sometimes extend out to a considerable distance into the mud, and are always completely covered at high water. A few miles distant from Elephant Point, the jungle in these swamps consists almost exclusively of a tall willow-like tree, *Sonneratia apetala*, which appeared to be a favourite resort for several species of King-fishers and Wood-peckers. With the exception, however, of this solitary patch of *Sonneratia*, the tidal jungles were mainly composed of such plants as *Ceriops Roxburghiana*, *Acanthus ilicifolius*, and various species of mangroves.

Beyond the sandy beach in the neighbourhood of Elephant Point, the country is under cultivation, and, with the exception of a few isolated clumps of trees, hedges, and small patches of thin tree jungle and scrub, it is quite open. At a little distance to the westward, however, cultivation ceases, and for several miles along the shore, a dense low jungle comes down quite close to the beach. Sometimes at very high spring tides this jungle is completely flooded for several miles inland. It is composed mainly of low-growing trees and shrubs,

such as *Hibiscus tiliaceus*, *Clerodendron inerme*, *Derris scandens*, *Grewiamicrocos*, *Glycosmis pentaphylla*, *Jasminum scandens*, *Flagellaria indica*, and others, amongst which very few birds indeed are to be found.

About midway between Elephant Point and China-Ba-keer, this low jungle is found to pass abruptly into an open grass covered country, which continues almost up to China-Ba-keer, and is in a few places irregularly dotted with hedges and scrub. Inside this open grass land, there are broad belts of evergreen forest, running more or less paralleled to the shore, and in many places rendered quite impenetrable by the Liana-like creepers and thick thorny under-wood beneath.

In addition to all these varieties of country, numerous swamps and jheels of varying extent are to be met with at intervals. Some of these are quite open and clear, or at the most only fringed with weeds, but the greater number are completely covered with aquatic plants, and are the favoured haunts of numberless Herons and other water birds.

34.—*Spizaetus caligatus*, Raffles.

This appears to be a rare species. I only saw a single specimen which I shot near China-Ba-keer in December. It was perching upon one of the lower branches of a large tree overhanging a jheel, from whence it appeared to be watching for frogs or fish. It was a male, and gave the following measurements in the flesh:—

Length, 26·2; expanse, 51·5; tail from vent, 12·1; wing, 16·8; tarsus, 4·25; bill from gape, 1·85.

The irides were light yellowish brown; cere and bill, dusky black; feet, light yellow; toes, with three or four very large scutella at base of claws; claws, black.

41.—*Polioctetus ichthyostus*, Horsf.

This species appeared to be scarce. I have not been able to identify it along the coast line, although it is not improbable that it occurs there along with *Cuncuma leucogaster*. I have only shot a single specimen at a considerable distance up the Rangoon river, where the white-bellied Sea Eagle does not appear to extend to. It was an immature female in the lined stage, and gave the following measurements recorded in the flesh:—

Length, 28; expanse, 61; tail from vent, 12·2; wing, 18·2; tarsus, 3·55; bill from gape, 2·2.

The irides were light yellowish brown; cere, slaty grey; bill, dark dusky slate color, lighter towards base; legs and feet, thick, coarse, and strong, and of a dirty light yellow color; claws, black.

43.—*Cuncuma leucogaster*, Gmel.

The white-bellied Sea Eagle was to be met with, though sparingly, all along the coast from Elephant Point up to China-Ba-keer. It was not unusual to see a pair or more of these birds high up in the air, and far out of the reach of shot, wheeling and circling round and round, with a peculiarly easy and graceful flight. It was very seldom indeed that one would come within shooting distance, so that it was a matter of considerable difficulty to obtain specimens. I killed one male bird at China-Ba-keer, of which the following are the dimensions in the flesh:—

Length, 27·75; expanse, 71; tail from vent, 10·5; wing, 22; tarsus, 3·7; bill from gape, 2·25.

The irides were light brown; cere and gape, leaden grey; upper mandible, dusky brown shading into a greyish blue towards its junction with the cere; lower mandible, bluish grey, tipped with dusky brown; legs and feet, dirty yellowish white; claws, black.

48 ter.—*Poliornis liventer*, Tem.

This species is by no means very uncommon in the immediate vicinity of Elephant Point where it frequents the extensive paddy-fields in that locality. These birds may be often seen in the early morning coursing along with a graceful swooping flight from one field to another, never rising to any height, but generally flying quite close to the ground, and when tired, settling down to rest on the slightly elevated boundaries between the fields. They are particularly wary and difficult to approach. The following are the dimensions recorded in the flesh of a fine male bird killed at Elephant Point:—

Length, 15·8; expanse, 37·75; tail from vent, 6·5; wing, 11·5; tarsus, 2·6; bill from gape, 1·4; mid toe and claw, 2·05.

The irides were of a beautiful lemon yellow color; cere, orange; both mandibles, orange yellow, tipped with dusky brown; legs and feet, bright yellow; claws, dusky black.

53.—*Circus melanoleucus*, Gmel.

This bird was abundant in the neighbourhood of Rangoon, and was likewise numerous in suitable localities between Elephant Point and China-Ba-keer. Like *Poliornis liventer* it seemed to prefer hunting for its prey over the rice-fields and open waste ground. I shot three birds which, although differing very much *inter se* in coloration, are all referable to this species. The following are their dimensions recorded in the flesh:—

Adult male.—Length, 18·5; expanse, 41·75; tail from vent, 8·5; wing, 14; tarsus, 3·05; bill from gape, 1·2; mid toe and claw, 1·75. Irides, bright yellow; cere, dark slaty grey; bill, dusky black; legs and feet, chrome yellow; claws, black.

Male, juv.—Length, 18; expanse, 40; tail from vent, 8·5; wing, 13·5; tarsus, 3·1; bill from gape, 1·25; mid toe and claw, 1·75. Irides, yellow; cere, slaty greenish grey; bill, dusky black; lower mandible, lighter colored near base; legs and feet, orange yellow; claws, dusky black.

Female, juv.—Length, 18·75; expanse, 43·25; tail from vent, 8·6; wing, 14·4; tarsus, 3·25; bill from gape, 1·25; mid toe and claw, 1·85. Irides, light brownish yellow; cere, slaty greenish grey; bill, dusky black; legs and feet, orange yellow; claws, black.

56 ter.—*Milvus affinis*, Gould.

This species was met with everywhere, but was abundant only in the vicinity of villages I observed a single pair breeding in the middle of January. They had their nest in the fork of a large acacia tree, growing close to the shore at Eastern Grove, several miles distant from the nearest village. The female was sitting on her nest, but I shot the male as he was flying around. The following measurements were recorded in the flesh:—

Length, 25·2; expanse, 52·5; tail from vent, 12·5; wing, 17·5; tarsus, 2·5; bill from gape, 1·8.

60.—*Strix indica*, Blyth.

I have only met with the Indian Screech Owl at Elephant Point, where it was by no means abundant. I killed two specimens there amongst some tall densely foliated trees whither for several evenings I had observed them to resort. The male bird was somewhat larger than the female, and measured in the flesh:—

Length, 14·8; expanse, 39·75; tail from vent, 5·2; wing, 11·5; tarsus, 2·75; bill from gape, 1·7.

Female. Length, 14·5; expanse, 38·25; tail from vent, 4·7; tarsus, 2·75; bill from gape, 1·75; wing, 11.

In both sexes the irides were deep brown; bill, yellowish white; cere, pinkish white; legs and feet, dusky yellowish brown; claws, horny brown.

72.—*Ketupa ceylonensis*, Gmel.

This handsome Owl was tolerably abundant in the thin forest jungle surrounding the different jheels lying between Elephant Point and China-Ba-keer. The following are the dimensions recorded in the flesh of female birds shot at Elephant Point:—

Length, 21·5 to 22·15; expanse, 46·75 to 49·5; tail from vent, 7·5 to 7·75; wing, 14·9 to 15·7; tarsus, 3·15 to 3·2; bill from gape, 2·25 to 2·3.

The irides were bright golden yellow; the bills horny or slaty grey; the legs and feet were dirty yellow; and the claws dusky brown.

72 bis.—*Ketupa javanensis*, Less.

The Malay Fish Owl was abundant in the jungle bordering the numerous creeks which flow into the Rangoon river near its mouth. Just after sun-set these birds begin to issue from the surrounding jungle, and with a powerful, though somewhat heavy flight, hunt for their prey up and down along the course of the creek, resting now and then in some adjacent mangrove. The following are the dimensions recorded in the flesh of a male bird shot in Deserter's Creek:—

Length, 19; expanse, 46·5; tail from vent, 6·8; wing, 13·9; tarsus, 2·95; bill from gape, 1·95.

The irides were light yellow; cere, dark slate color; bill, dusky; legs and feet, dusky yellowish brown.

81.—*Ninox scutellatus*, Raffles, apud Sharpe.

I found this species abundantly amongst the clumps of trees and thin jungle near the shore at Elephant Point, where they appear to feed principally upon a species of crab, *Ocypode platyptera*, which occurs in immense profusion upon the sands in that locality. I found the debris of these crabs in the stomachs of nearly all those which I examined. There does not appear to be any important difference in size between the two sexes. The following are the dimensions of six specimens recorded in the flesh:—

Length, 11·5 to 13·5; expanse, 24·75 to 28; wing, 8·2 to 8·7; tail from vent, 5 to 5·5; tarsus, 1 to 1·25; bill from gape, .9 to 1·1.

The irides were bright yellow; cere, dark slaty green; bill, dusky black, margined with greyish; legs and feet, dusky yellow; claws, horny brown.

82.—*Hirundo rustica*, Lin.

This was the only Swallow I met with, and it occurred in the greatest abundance everywhere. At Elephant Point along the shore vast swarms were always present, roosting at night on the sands a little above high water mark. Male birds measure somewhat more than females. The following is a résumé of the dimensions of both sexes recorded in the flesh:—

Males.—Length, 5·75 to 6·3; wing, 4·45 to 4·75; tail from vent to end of outer feathers, 2·75 to 3·5; to end of mid feathers, 1·8 to 2·1; tarsus, .42 to .46; bill from gape, .55 to .6; at front .3; width at gape, .52 to .6.

Females.—Length, 5·25 to 5·6; wing, 4·3 to 4·5; tail from vent to end of outer feathers, 2·5 to 2·6; to end of mid feathers, 1·8 to 2·1; tarsus .43 to .44; bill from gape, .55 to .57; at front, .3; width at gape, .45 to .47.

In both sexes the irides are deep brown; bill, legs, feet, and claws, dusky black.

117.—*Merops viridis*, Lin.

The common Indian Bee-eater was very generally distributed over every portion of Southern Pegu which I visited. It was especially abundant at the mouth of the Rangoon river, and from there all along the coast up to China-Ba-keer, where hundreds might be seen perched upon the dead bushes and drift wood washed up along the margin of the shore just above high water mark. They were here wonderfully tame, allowing me to get within two or three yards of them before they would attempt to fly away. The following is a résumé of the dimensions of several specimens recorded in the flesh:—

Length, 9 to 9·5; expanse, 11·5 to 12·1; tail from vent, 3·7 to 3·8; wing, 4·6 to 5·2; tarsus, .35 to .4; bill from gape, 1·3 to 1·45.

Irides, deep red; bill, dusky black; legs and feet, greyish black; claws, horny brown.

118.—*Merops Daudini*, Cuv.

This species, though tolerably abundant in certain localities, was by no means general in its distribution. I have only met with it in a tidal swamp a few miles from Elephant Point and also along the course of Deserter's Creek. In this latter locality it was met with in tolerable abundance, more especially where the margins were bordered with tall *Sonneratia* trees. Here numbers of this species might be seen making wide circles, with a strong rapid flight at a great height up in the air, again returning to perch on the summits of these trees, where they would remain for a moment or two before starting on a fresh expedition. They kept, as a rule, to the highest trees, and were very wary and difficult to approach. A male bird shot near Elephant Point measured in the flesh:—

Length, 12·1; expanse, 15·6; tail from vent, 5·5; wing, 5·45; tarsus, .5; bill from gape, 1·95.

The irides were deep crimson; bill, black; legs and feet, dusky greyish black; claws, horny brown.

119.—*Merops Swinhoci*, Hume.

The Chestnut-headed Bee-eater occurred very sparingly in Southern Pegu. During the months of November, December, and January, I did not meet with any specimen of this species, but during the latter end of February I saw several pairs near Elephant Point. They were all remarkably shy, and when disturbed flew away quite out of sight. A male bird shot in the vicinity of Elephant Point measured in the flesh:—

Length, 8·75; expanse, 12·5; tail from vent, 8·5; wing, 4·2; tarsus, .4; bill from gape, 1·65.

Irides, crimson; bill, black; legs and feet, dusky pink; claws, brownish.

124.—*Coracias affinis*, McClell.

This bird, without being numerous anywhere, was universal in its distribution over the entire district. Wherever there were clumps of trees, bushes or hedges in open cultivated or waste ground, this species might be seen perching usually upon some dry leafless branch or twig. It was, however, excessively wary, so that it was not always easy to procure specimens. The following is a résumé of the dimensions of several specimens recorded in the flesh:—

Length, 12·5 to 13·75; expanse, 22·5 to 13·7; tail from vent, 5 to 5·3; wing, 7·2 to 7·5; tarsus, 1·0 to 1·5; bill from gape, 1·6 to 1·8.

Irides, light red; bill, black; legs and feet, ashy grey; claws, black.

128.—*Pelargopsis amauroptera*, Pearson.

This handsome King-fisher was by no means abundant anywhere. I have only met with it amongst the mangrove jungle which borders the margins of the larger creeks flowing into the Rangoon river near its mouth. It is very shy and difficult to approach, and when disturbed, flies away with a harsh cry into the thickest jungle it can find. Male birds appear to be somewhat larger than the females. The following are the dimensions of three specimens shot on the banks of Deserter's Creek:—

Length, 14·5 to 5; expanse, 20·3 to 20·7; wing, 5·7 to 6; tail from vent, 4·1 to 4·4; tarsus, 0·6 to 0·7; bill from gape, 3·3 to 3·7.

The irides vary from light to deep brown; the eyelids are margined with orange beading; gape, deep salmon or orange red; bill, bright vermillion, tipped with dusky; legs and feet, orange red; claws, dusky black.

129.—*Halcyon smyrnensis*, Lin.

This species was universally distributed over the entire district, and tolerably abundant everywhere. It was found in low jungle, and thin forest in open ground as well as along the margins of all the nullahs and streams in the vicinity. The following are the dimensions recorded in the flesh of ten specimens from Elephant Point, China-Ba-keer, Deserter's Creek, Rangoon, Syriam, and Eastern Grove:—

Nine males.—Length, 10·7 to 11·5; expanse, 14·25 to 15·5; wing 4·5 to 4·95; tail from vent, 3·2 to 3·7; tarsus, .6 to .65; bill from gape, 2·7 to 2·9.

One female.—Length, 10·7; expanse, 14·75; wing, 4·55; tail from vent, 3; tarsus, .62; bill from gape, 2·7.

The irides are dark brown; bill, dusky red, tipped with blackish brown; legs and feet, brownish red; claws, dark brown.

130.—*Halcyon pileata*, Bodd.

This beautiful King-fisher formed a marked characteristic of the avi-fauna belonging to the Rangoon district of the Irrawaddy delta. It was to be seen everywhere. It was abundant amongst the mangroves on each side of every creek and nullah. The shore jungle along the coast, from Elephant Point up as far as China-Ba-keer, resounded with its discordant cry. Under every little dry projecting twig along the sea shore, a quantity of white excreta and remains of the legs and bodies of small crabs showed where one of these birds had been making its dinner and indulging in its siesta. Each bird appears to have its own favorite watch tower and, when disturbed, flies away with a shrill cry, taking a semicircular swoop to some dry twig ahead, and, as soon as it thinks that the danger is passed by, returns again to the post from which it had been dislodged. The following is a *résumé* of the dimensions recorded in the flesh of numerous examples of this species:—

Length, 11·7 to 12·5; expanse 18 to 18·75; tail from vent, 3·8 to 3·75; wing, 4·9 to 5·3; tarsus, .6 to .7; bill from gape, 2·9 to 3·15.

Irides, reddish brown or dark brown; bill, deep coral red; legs and feet, dusky brownish red; claws, horny brown.

132.—*Halcyon chloris*, Bodd.

The White-collared King-fisher occurs, though very sparingly, throughout the tidal swamp intervening between Elephant Point and China-Ba-keer. It was perhaps more frequently met with amongst the mangroves bordering the larger nullahs and creeks near the mouth of the Rangoon river, feeding upon the small crabs and fish, which at ebb-tide swarm upon the mud in those localities. I obtained four specimens, of which the following are the dimensions recorded in the flesh:—

Length, 10 to 10·25; expanse, 14 to 15; wing 4·43; tail from vent, 2·8 to 3; tarsus, .6 to .63; bill from gape, 2·1 to 2·3.

Irides, dark reddish brown; upper mandible, dusky greenish, black; lower mandible, pinkish or yellowish white, tipped and margined with greenish black legs and feet, slaty grey.

134.—*Alcedo bengalensis*, Gm.

The common Indian King-fisher was tolerably abundant along all the nullahs and creeks in the vicinity of Elephant Point and Eastern Grove. It does not, however, appear to frequent the more extensive mangrove swamps along the coasts between the Rangoon and China-Ba-keer rivers. The dimensions of four specimens recorded in the flesh are as follows:—

Length, 6·3 to 6·6; expanse, 9·4 to 9·75; tail from vent, 1·3 to 1·5; wing, 2·75 to 2·8; tarsus, .85; bill from gape, 1·8 to 2; bill at front, 1·35 to 1·45.

Irides, dark brown; upper mandible, black; lower mandible, either black or brownish white, tipped and margined with dusky black; legs and feet, dull red; claws, brown.

147 bis.—*Palaeornis magnirostris*, Ball.

Birds of this species were very abundant in the district about Elephant Point. They used to select the adjacent paddy-fields for their feeding grounds, remaining there throughout the day-time. Towards evening, however, they would return in large parties to roost amongst some isolated clumps of tall trees which were scattered here and there over the neighbourhood. I observed them breeding in the trunks of trees towards the end of January and throughout February. The following is a *résumé* of the dimensions of six specimens recorded in the flesh:—

Three males.—Length, 20 to 21; expanse, 22·5 to 23; tail from vent, 13 to 13·6; wing, 7·6 to 8; tarsus, .73 to .75; bill from gape, 1·2 to 1·3; from base of culmen to tip, 1·4 to 1·5; height of bill at base, 1·35 to 1·47.

Three females.—Length, 17 to 20; expanse, 21·5 to 22·75; tail from vent, 10·2 to 12·6; wing, 7·3 to 7·7; tarsus, .72 to .75; bill from gape, 1·05 to 1·25; from base of culmen to tip, 1·35 to 1·4; height of bill at base, 1·4 to 1·45.

In both sexes the irides were of a pale yellowish white; bill, crimson, tipped with dirty yellow, apparently the result of attrition; legs and feet, bright yellow.

149 bis.—*Palaeornis bengalensis*, Gm.

This species was tolerably abundant in the forest districts lying between Elephant Point and China-Ba-keer. I have always found them consorting in parties of from seven or ten to twenty or thirty. They are very noisy birds, giving utterance to a harsh screaming cry during their flight, which is extremely rapid and powerful. The following is a *résumé* of the dimensions of eight specimens recorded in the flesh:—

Four males.—Length, 11·5 to 13; expanse, 15·7 to 16·5; tail from vent, 6·7 to 7·5; wing, 5·2 to 5·7; tarsus, .5 to .6; bill from gape, .65 to .75.

Four females.—Length, 10·5 to 11; expanse, 15·2 to 15·7; tail from vent, 5·7 to 6·3; tarsus, .5 to .6; wing, 5 to 5·25; bill from gape, .65 to .7.

In both sexes the irides were light pinkish or yellowish white; upper mandible, orange or dark yellow, becoming lighter towards the point which is tipped with greyish white; lower mandible, black; legs and feet, dirty black.

152.—*Palaeornis melanorhynchus*, Wagler.

This species was more numerous and more generally distributed than either *magnirostris* or *bengalensis*. It is usually gregarious in its habits, but I have not infrequently found it solitary. It occurs most abundantly in the vicinity of flowering trees, upon the flower and leaf buds of which it feeds. It is much more familiar than any other species of Parrot which I met with, and if one of a flock should happen to be wounded, its calling will bring the whole party flying round almost within arm's length, the entire number keeping up all the time an unceasing din of not unpleasing chatter. Male birds measure in the flesh:—

Length, 13·75 to 14·5; expanse, 19·25 to 20·5; tail from vent, 6·7 to 7·5; wing, 6·6 to 6·8; tarsus, .65 to .7; bill from gape, .9 to 1.

Females.—Length, 13·5 to 14·2; expanse, 19 to 20; wing, 6·5 to 6·7; tail from vent, 7 to 7·3; tarsus, .6 to .7; bill from gape, .85 to 1.

In both sexes the irides are pearly white; the legs and feet, greenish grey. In the adult male the upper mandible is bright vermillion red, tipped more or less with yellowish white, while in the adult females and young males it is dusky black; in both sexes the lower mandible is black.

153.—*Loriculus vernalis*, Sparrm.

The Indian Lorikeet was by no means abundant. I have only met with it in the thin forest jungle at Elephant Point and near China-Ba-keer. The birds are very active little creatures, and have a curious habit of ascending the branch of a tree in a spiral path, making numerous circuits of the stem before reaching the extremity. Their cry is harsh and discordant. The following are the measurements of three specimens recorded in the flesh:—

Length, 5·55 to 5·75; expanse, 8·75 to 9·6; wing, 3·4 to 3·6; tail from vent, 1·55 to 1·7; tarsus, 0·45 to 0·5; bill from gape, 0·45 to 0·5.

The irides are white; bill, orange yellow; legs and feet, yellow; claws, dusky brown.

157 *ter*.—*Analis*, Horsf.—

This species was only met with in the thin tree jungle close to Elephant Point, where it was decidedly rare. Two females measured in the flesh:—

Length, 7 to 7·3; expanse, 11·5 to 11·6; tail from vent 2·5; wing, 8·9 to 8·8; tarsus, .65 to .7; bill from gape, 1 to 9·5.

Irides, dark brown; bill, dull greenish black; legs and feet, dusky greyish; claws, black.

163 *bis*.—*Yungipicus canicapillus*, Blyth.

This species appears to be extremely local in its distribution. I have only met with it in a patch of tall willow-like trees ("*Sanneratia apetala*"), growing in a tidal jungle a few miles from Elephant Point. During the mornings and evenings they occurred in great abundance amongst the branches of these trees, but during the heat of the day they always retired for shelter to the thick underwood adjoining. The following are the dimensions of six specimens recorded in the flesh:—

Three males.—Length, 5·5 to 5·8; expanse, 10·3 to 10·6; tail from vent, 1·7 to 1·9; wing, 8·15 to 8·2; tarsus, .55 to .6; bill from gape, .72 to .8.

Three females.—Length, 5·3 to 5·6; expanse, 10·2 to 10·5; tail from vent, 1·7 to 1·9; wing, 8·05 to 8·15; tarsus, .5 to .6; bill from gape, .7 to .75.

In both sexes the irides vary from light to dark brown; bill, dark, greenish black; legs and feet, dull greenish slate color; claws, horny brown.

166.—*Chrysocolaptes sultaneus*, Hodges.

In the belts of forest trees between Elephant Point and China-Ba-keer, this species was met with in abundance. It flies with considerable rapidity from tree to tree, the branches of which it ascends by a series of jerks. During its flight it utters a harsh scream, which it discontinues as soon as it alights. The following are the dimensions of several specimens recorded in the flesh:—

Males.—Length, 12·5 to 12·75; expanse, 20·25 to 21·5; tail from vent, 4·1 to 4·7; wing, 6·15 to 6·65; tarsus, 1·15 to 1·2; bill from gape, 2·1 to 2·2.

Females.—Length, 11·5 to 12·2; expanse, 20·1 to 20·75; tail from vent, 4 to 4·8; wing, 6·2 to 6·5; tarsus, 1·15 to 1·2; bill from gape, 1·85 to 2.

In both sexes the irides were white, with a tinge of pink shading into brownish at the sclerotic margin; bill, legs, and feet of a dark slate color; claws, dusky black.

171 *bis*.—*Gecinus vittatus*, Vieillot.

This species of Woodpecker appears to be rare in Southern Pegu. I have only met with three or four specimens in the forest jungle near China-Ba-keer. Two males measured in the flesh:—

Length, 12·2 to 12·8; expanse, 16·2 to 17·75; tail from vent, 4·8 to 4·9; wing, 5·45 to 5·5; tarsus, 1·1; bill from gape, 1·6 to 1·7.

The irides were dull red; upper mandible, dusky black; lower mandible, brownish yellow, tipped with dusky; legs, feet, and claws, dull greenish black.

184.—*Tiga intermedia*, Blyth.

I found this species to be more common and more generally distributed than any other Wood pecker. It was especially numerous in the vicinity of China-Ba-keer, where there are

belts of tall forest trees running parallel to the shore. From sunrise until nearly noon, this region resounds with the harsh cry, which, like *Chrysocolaptes sultaneus*, they only utter when on the wing, flying from tree to tree. Like that species too they always alight on the lower part of the trunk or branch, ascending by a series of jerks, and stopping frequently to gather insects from the bark, or to have a look around them. During their flight they make with their wings a peculiar whirring noise, which I have not remarked during the flight of *Chrysocolaptes sultaneus*. The following are the dimensions of six specimens recorded in the flesh :—

Three males.—Length, 10·5 to 11·6; expanse, 16·8 to 17·7; tail from vent, 4 to 4·3; wing, 5·45 to 5·75; tarsus, 1 to 1·1; bill from gape, 1·3 to 1·4.

Three females.—Length, 10·75 to 11·25; expanse, 16·5 to 17·75; tail from vent, 4·1 to 4·4; wing, 5·5 to 5·8; tarsus, 0·95 to 1·05; bill from gape, 1·25 to 1·3.

Irides, bright red; bill, dull bluish black; legs and feet, slate color.

197.—*Xantholæma haemacephala*, Müll.

Wherever there was thin forest jungle or clumps of trees, this species was to be met with in abundance. They frequented, as a rule, the outskirts of the forest, perching on the tops of the trees, and giving utterance to their peculiar monotonous call, which may be distinctly heard at a distance of more than a quarter of a mile. The following is a résumé of the dimensions of four male birds recorded in the flesh :—

Length, 5·5 to 6·7; expanse, 10·2 to 10·65; tail from vent, 1·5 to 1·7; wing 3·2 to 3·7; tarsus, 0·75 to 0·85; bill from gape, 0·9 to 1·05.

Irides, dark reddish brown; bill, dusky black; legs and feet, red; claws, black.

207.—*Hierococcyx sparveroides*, Vigors.

This species is undoubtedly rare. I have only met with it on two or three occasions, and always in the thickest part of the forest jungle near China-Ba-keer. A male specimen shot on the 19th December measured in the flesh :—

Length, 15·7; expanse, 25·3; tail from vent, 8·75; wing, 9·25; tarsus, 1; bill from gape, 1·4.

Irides, rich yellow; eyelids, margined with orange yellow; upper mandible, dull greenish black; lower mandible, dusky horny green, shading into dirty yellow towards the point, which is tipped with dusky black; legs, feet, soles, and claws, bright yellow. The contents of the stomach consisted almost entirely of portions of grasshoppers and beetles.

209.—*Cacomantis rufiventra*, Jerd.

This species was universally distributed over the entire region lying between Rangoon and China-Ba-keer, but did not appear to be abundant anywhere. They were generally met with in pairs, frequenting the open ground at the outskirts of forest jungle, keeping almost exclusively to low bushes or hedges. There does not seem to be any appreciable difference of size between the two sexes. The following is a résumé of the dimensions of five specimens recorded in the flesh :—

Length, 8·75 to 9·5; expanse, 15·1 to 15·6; tail from vent, 4·5 to 5·1; wing, 4·45 to 4·6; tarsus, 0·6 to 0·65, bill from gape, 0·9 to 1.

Irides, brown; upper mandible, reddish black; lower mandible, yellowish brown, tipped with dusky; gape deep salmon red; legs and feet, yellowish brown; claws, black.

215.—*Rhodophytes tristis*, Less.

This species was not uncommon amongst the coves and thickets in the forest jungle between Elephant Point and China-Ba-keer. Several specimens measured in the flesh show the following result :—

Length, 20·5 to 22·5; expanse, 16·2 to 18·2; tail from vent, 13·2 to 16·5; tarsus, 1·55 to 1·65; bill from gape, 1·5 to 1·65. Irides, brownish red; lores, crimson; bill, bright horny green, darker towards the base; legs and feet, greenish black; claws, dark brown.

217 *quat.*—*Centrococcyx erycercus*, Hay.

This species was generally distributed, though far from abundant anywhere. I only obtained a single specimen which I shot near Elephant Point; it was a female and measured in the flesh :—

Length, 20·5; expanse, 24; tail from vent, 10·75; wing, 7·9; tarsus, 2·4; bill from gape, 1·9.

Irides, crimson; bill, dusky black, whitish at extreme point; legs and feet, dark slaty black; claws, black.

233 *bis.*—*Chalcoparia cingalensis*, Gmel.

I have only met with this species at Syriam and the vicinity of Elephant Point, where, however, they appear to scarce. They frequent the thin shrubby jungle in those localities. The following are the dimensions of three specimens recorded in the flesh :—

A male measured.—Length, 4·3; expanse, 6·2; wing, 2·2; tail from vent, 1·75; tarsus, 0·6; bill from gape, 0·6.

Two females.—Length, 4 to 4·1; expanse, 5·8 to 5·9; wing, 2·05 to 2·15; tail from vent, 1·55 to 1·6; tarsus, 0·58 to 0·6; bill from gape, 0·55 to 0·58.

In both sexes the irides are bright red; bill, dusky black; legs and feet, dull greenish black.

234.—*Arachnechthra asiatica*, Lin.

In the neighbourhoods of Rangoon and Syriam this species was extremely abundant, but I have only met with it two or three times between Elephant Point and China-Ba-keer.

Male birds measure in the flesh:—

Length, 4·4 to 4·7; expanse, 6·7 to 6·8; wing, 2·15 to 2·2; tail, 1·4 to 1·55; tarsus, .52 to .6; bill from gape, .8 to .85.

A female measured in the flesh:—

Length, 4·4; expanse, 6·75; wing, 2·15; tail from vent, 1·35; tarsus, .55; bill from gape, .8.

Irides, brown; bill, legs, feet, and claws, black.

234 ter.—*Arachnechthra flammavillaris*, Blyth.

This species, though not abundant anywhere, was met with generally throughout the district. Five males measured in the flesh:—

Length, 4·3 to 4·6; expanse, 6 to 6·25; wing, 1·97 to 2·1; tail from vent, 1·35 to 1·5; tarsus, .5 to .55; bill from gape, .75 to .8.

A female measured in the flesh:—

Length, 4·25; expanse, 6; wing, 2; tail from vent, 1·5; tarsus, .58; bill from the gape, .8.

In all the irides were red; bill, legs, feet, and claws, black.

236.—*Dicæum cruentatum*, Lin.

I have met with this species only in the immediate vicinity of Rangoon, where it was extremely abundant. They are met with most abundantly during the hottest part of the day, frequenting thin trees or open forest jungle. They flit about with great activity from tree to tree, usually in small parties of four or five, giving utterance all the time to small chirruping notes. The following is a *résumé* of the dimensions of six males recorded in the flesh:—

Length, 3·25 to 3·5; expanse, 5·8 to 6·1; wing, 1·85 to 1·95; tail from vent, 1·1 to 1·15; tarsus, .45 to .5; bill from gape, .5 to .55.

A female measured in the flesh:—

Length, 3·3; expanse, 5·65; wing, 1·75; tail from vent, 1·1; tarsus, .46; bill from gape, .5.

In both sexes the irides were reddish brown; bill, legs and feet, black.

254 bis.—*Upupa longirostris*, Jerd.

This species appeared to avoid forest jungle, but was very abundant in the open cultivated or waste ground, frequenting the shrubs and hedges in those localities. I have usually found it consorting in pairs. The following is a *résumé* of six specimens, the dimensions of which have been recorded in the flesh:—

Two males.—Length, 11·7 to 12·2; expanse, 17 to 17·4; wing, 5·45 to 5·5; tail from vent, 4·1 to 4·4; tarsus, .95; bill from gape, 2·55 to 2·75; from forehead to tip, 2·42 to 2·6; from anterior margin of nares to tip, 2 to 2·2.

Four females.—Length, 11·2 to 11·75; expanse, 16·5 to 17; wing, 5·1 to 5·3; tail from vent, 3·9 to 4; tarsus, .93 to .95; bill from gape, 2·37 to 2·52; from forehead to tip, 2·25 to 2·37; from anterior margin of nares to tip, 1·85 to 2.

In both sexes the irides were light brown; bill, dusky black, paler towards base; feet, legs, and claws, dark slate color.

260 bis.—*Lanius colluriooides*, Less. (*L. hypoleucus*, Blyth).

I have only seen this species at Rangoon, where it was decidedly scarce. They frequent the thick bushes and hedges in the neighbourhood. The following are the measurements of two male birds recorded in the flesh:—

Length, 7·6 to 7·8; expanse, 10·7 to 10·5; wing, 8·4 to 8·35; tail from vent, 8·55 to 8·75; tarsus, 1; bill from gape, .9 to .85.

Irides, reddish brown; upper mandible, dusky black, margined near gape with yellowish white; lower mandible, yellowish white, tipped with dusky black; feet and legs, dusky.

261.—*Lanius cristatus*, Lin.

This Shrike, although far from being abundant, appears to be more generally distributed than *colluriooides*. It seems to prefer the vicinity of towns or villages, frequenting the thick low jungle in their vicinities. The following are the measurements recorded in the flesh of two specimens, a female and a male killed near Rangoon and Elephant Point respectively:—

Length, 7·4 to 7·6; expanse, 10·4 to 10·5; wing, 8·35; tail from vent, 8·2 to 8·3; tarsus, 1; bill from gape, .85 to .87.

Irides, dark brown; upper mandible, dusky black, margined with yellowish white near gape; lower mandible, dirty white, tipped with dusky black; legs and feet dusky brown.

270.—*Grancalus Macei*, Less.

This species occurs in tolerable abundance amongst the thin tree jungle at Syriam and Eastern Grove, as well as in similar localities between Elephant Point and China-Ba-keer. It frequents the tops of the taller trees, flying from one to another, and seldom, so far as I have observed, settling amongst any of the lower branches. There seems to be no appreciable

difference of size between the two sexes. The measurements of two males and two females recorded in the flesh are as follows:—

Length, 12 to 12.35; expanse 19.3 to 19.75; wing, 6.6 to 6.75; tail from vent, 5.2 to 5.5; tarsus, 1.05 to 1.1; bill from gape, 1.5 to 1.55.

The irides vary from brilliant light hazel to reddish or dark brown; bill, legs, and feet, black.

275.—*Pericrocotus roseus*, Vieillot.

This species occurs sparingly in the vicinities of Rangoon and Syriam, and I have also found it in the neighbourhood of China-Ba-keer. As a rule, it is solitary in its habits, and I have never met with more than a pair of these birds together. They seem to prefer high trees with loose foliage, such as *Casuarinas* and *Sonnaratias*, amongst the branches of which they hop about with great rapidity. The following result is obtained from the measurements of three males recorded in the flesh:—

Length, 7.2 to 7.3; expanse, 9.8 to 10.3; wing, 3.3 to 3.45; tail from vent, 3.3 to 3.7; tarsus, .6 to .65; bill from gape, .75 to .8. Irides, dark brown; bill, legs, and feet, black.

This species was abundant at Rangoon and Syriam as well as throughout the entire district intervening between Elephant Point and China-Ba-keer. It occurred in greatest numbers along the borders of the forest jungle, and I have always met with it consorting with several others of the same species. They measure in the flesh:—

Length, 5.7 to 6; expanse, 8.4 to 8.8; wing 6.5 to 2.27; tail from vent, 2.7 to 2.8; tarsus, .6 to .62; bill from gape .62 to .65.

Irides, dark brown; bill, legs, and feet, dusky black.

278.—*Buchanga albiricta*, Hodge.

The Common Drongo Shrike occurred in abundance everywhere. It was to be found alike on the outskirts of forests, in the vicinity of villages and along the sea-shore. The following is a résumé of the dimensions of six specimens recorded in the flesh:—

Three males.—Length 10.55 to 11; expanse, 16.6 to 17.25; wing, 5.7 to 5.9; tail from vent, 5.6 to 5.9; tarsus, .7 to .72; bill from gape, 1.05 to 1.1.

Three females.—Length, 10.35 to 11; expanse, 15.5 to 16.7; wing, 5.2 to 5.55; tail from vent, 5 to 5.8; tarsus, .67 to .7; bill from gape, 1.05 to 1.1.

In both sexes the irides vary from brown or reddish brown to bright red; the bill, legs, and feet, are black.

280 A.—*Buchanga intermedia*, Blyth.

The ashy drongos collected from the neighbourhoods of Rangoon and Syriam, as well as those from the district intervening between Elephant Point and China-Ba-keer, may, from their relative dimensions, be arbitrarily divided into two *quasi* species. The larger birds are probably referable to the *Buchanga pyrrhops* of Hodgson, although their dimensions are somewhat less than those given by Mr. Grote for that species; while the smaller variety may, I think, with equal probability be referred to the *Buchanga intermedia* of Blyth. The following are the dimensions recorded in the flesh of four specimens of *Intermedia*:—

	Sex.	Length.	Expanse.	Wing.	Outer tail feathers.	Middle tail feathers.	Tarsus.	Bill from gape.
1	♂	10	15.6	4.9	4.8	3.8	.76	1.05
2	"	10.3	16	5.1	5.2	3.9	.75	1.12
3	"	10.5	16.8	5.3	5.5	3.9	.73	1.07
4	"	10.4	16	5.2	5.6	4	.75	1.1

In all four specimens the irides were lake red; the bill, legs, feet, and claws, jetty black.

280 B.—*Buchanga pyrrhops*, Hodge.

The birds which have been referred to this species were as generally distributed and occurred in apparently as great abundance as the preceding. The following are the dimensions of four specimens recorded in the flesh:—

	Sex.	Length.	Expanse.	Wing.	Outer tail feathers.	Middle tail feathers.	Tarsus.	Bill from gape.
1	♂	11.2	17.25	5.65	6.8	4.5	.75	1.12
2	"	11	17.25	5.5	5.9	4.3	.75	1.15
3	"	11.5	17	5.6	6.4	4.5	.8	1.2
4	♀	10.75	17	5.4	5.6	4.3	.75	1.15

In all four specimens the irides were lake red, and the bill, legs, and feet, jetty black.

282.—*Chaptia senea*, Vieillot.

This species occurs very sparingly in the forest jungle near China-Ba-keer, but I have not met with it elsewhere. A male specimen measured in the flesh:—

Length, 8·7; expanse, 13·8; tail from vent, 4·6; wing, 4·75; tarsus, .7; bill from gape, 1.

Irides, dark reddish brown; bill, legs, and feet, deep black.

283.—*Bringa tectirostris*, Hodg.

This species was met with occasionally in the thick underwood of the tall forest jungle adjacent to China-Ba-keer, where however it was scarce. The following are the dimensions recorded in the flesh of two male birds, shot at China-Ba-keer in December, neither of which had by that time developed its long tail feathers:—

Length, 10·5 to 10·75; expanse, 15·9 to 16·25; wing, 5·15 to 5·2; tail from vent, 5·4 to 5·85; tarsus, .85; bill from gape, 1·1 to 1·15.

Irides, reddish brown; bill, legs, feet, and claws, black.

285 bis.—*Dissemurus paradiseus*, Lin. (Vide S. F., II, 212; III, 101.)

This species was met with in great abundance in the forest belts intervening between the Rangoon and China-Ba-keer rivers. It frequents the lower branches of the trees and the dense thorny underwood in those localities. The following are the measurements of six specimens recorded in the flesh:—

Three males.—Length, 20·5 to 22; expanse, 19·5 to 20; wing, 6·85 to 6·6; outer tail feathers 14·5 to 16·2; middle tail feathers, 5·8 to 6; tarsus, 1·2 to 1·25; bill from gape, 1·5 to 1·55.

Three females.—Length, 17·5 to 19·5; expanse, 18·5 to 19·25; wing, 6 to 6·2; outer tail feathers, 11·2 to 14; middle tail feathers, 5·5 to 6; tarsus, 1·15 to 2; bill from gape, 1·45 to 1·52.

Irides, dark brown or reddish brown; bill, legs, feet, and claws, black.

286.—*Chibia hottentota*, Lin.

Although this species was, as a rule, abundant in those localities where it occurred, yet it appeared to be very local in its distribution. I have met with it most abundantly near Syriam, where I shot some nine or ten specimens in a small clump of *acacias*, the flowers of which they were minutely examining, apparently in search of insects. These trees appeared to afford them such an abundant harvest of food, that, although they would all fly off at the report of the gun, yet after flying away to a short distance, they would almost immediately return to the same trees. I do not think that there could have been less than seventy or eighty of these birds feeding in this small clump of nine or ten *acacias*. There is no appreciable difference in the dimensions of the two sexes. The following is a résumé of the dimensions of eight males and four females recorded in the flesh:—

Length, 11·5 to 12·5; expanse, 18·75 to 20; wing, 5·9 to 6·55; tail from vent, 5·3 to 5·5; tarsus, 1 to 1·1; bill from gape, 1·45 to 1·7.

Irides, dark brown; bill, legs, feet, and claws, black.

287.—*Artamus fuscus*, Vieillot.

This bird was very abundant throughout the entire district. I have met with it at Rangoon, Syriam, Elephant Point, and China-Ba-keer. It was specially numerous in the vicinities of villages, where parties of from ten to twenty or more would perch in the upper branches of some tall tree, whence they would sally forth at intervals in quest of insects. Male birds measure in the flesh:—

Length, 7 to 7·5; expanse, 14·5 to 15; wing, 5 to 5·15; tail from vent, 2·3 to 2·5; tarsus, .6 to .7; bill from gape, .85 to .95.

A female measured in the flesh:—

Length, 7·3; expanse, 14·75; wing, 5·05; tail from vent, 2·3; tarsus, .6; bill from gape, .9.

In both sexes the irides are dark brown; bill, greenish blue, tipped with dusky; legs and feet dark; dark slate color.

290.—*Myiagra azurea*, Bodd.

This species was abundant throughout the entire district, frequenting for the most part the underwood in forest jungle. I have generally met with it in small parties of four or five, all of which were usually females. The male bird when met with was generally solitary, but now and then I observed one amongst a party of females. The females are somewhat smaller than the males.

Four females measured in the flesh:—

Length, 5·8 to 6·2; expanse, 5·75 to 6·5; wing 2·6 to 2·85; tail from vent, 2·6 to 2·9; tarsus, .65 to .67; bill from gape, .7 to .72.

A male specimen measured in the flesh:—

Length, 6·5; expanse, 6·75; wing 2·95; tail from vent, 2·9; tarsus, .75; bill from gape, .75.

Irides, dark brown; bill, indigo blue; legs and feet, slaty color.

295.—*Culicicapa cinereocapilla*, Vieillot.

I have only met with this bird in the neighbourhood of Rangoon, where it appears to be very rare. A male specimen shot in February measured in the flesh :—

Length, 4·6 ; expanse, 6·75 ; tail from vent, 1·95 ; wing, 2·4 ; tarsus, .55 ; bill from gape, .5.

Irides nearly black ; bill, dusky above, dirty white underneath ; legs and feet, brownish yellow.

296.—*Hemicelidon albicularis*, Gmel.

This species appears to be rare. I only obtained a single specimen which I shot amongst the loose thickets near Elephant Point. It was a female, and measured in the flesh :—

Length, 4·7 ; expanse, 9·75 ; tail from vent, 2 ; wing, 2·9 ; tarsus, .55 ; bill from gape, .58, width at rictus, .37.

Irides, dark brown : upper mandible, dusky black ; lower mandible, yellowish brown, tipped with dusky ; legs and feet, brownish black.

301.—*Eumyias melanops*, Vigors.

This species occurred in tolerable abundance both at Syriam and Elephant Point. It appears to frequent alike the hedges and thickets in the sides of hills and in open waste ground as well as the low thin jungle in mangrove swamps. The following are the dimensions of five specimens recorded in the flesh :—

Two males.—Length, 6·5 to 6·7 ; expanse, 10·75 to 11 ; wing, 3·45 to 3·5 ; tail from vent, 2·95 to 3·1 ; tarsus, .62 to .63 ; bill from gape, .66 to .68.

Three females.—Length, 6·2 to 6·4 : expanse, 10·4 to 10·6, wing, 3·15 to 3·2 ; tail from vent, 2·6 to 2·9 ; tarsus, .62 to .68 ; bill from gape, .6 to .65.

Irides, dark brown ; bill, legs, and feet, black.

323.—*Erythrosterna leucura*, Gmel.

This is evidently a rare species throughout the district. I have only seen a single specimen, which I shot in December at Elephant Point. It was a female, and measured in the flesh :—

Length, 5·3 ; expanse, 8·25 ; tail from vent, 2 : wing, 2·65 ; tarsus, .72 ; bill from gape, .63.

Irides, very dark brown ; bill, dusky brown, lighter underneath ; legs and feet, dusky black.

371.—*Oreocincla dauma*, Lath.

I have only seen a single specimen of this bird, which I shot on the 18th December, in the forest jungle near China-Ba-keer. It was busily occupied picking up insects on the ground, and, on being disturbed, flew away into a tree, where it was shot. It was a fine male bird, and measured in the flesh :—

Length, 11·3 ; expanse, 17·25 ; tail from vent, 4·35 ; wing, 5·6 ; tarsus, 1·35 ; bill from gape, 1·25.

Irides, dark brown ; upper mandible, dusky black ; basal half of lower mandible, yellowish brown ; terminal, half dusky ; legs and feet, yellowish brown ; claws, horny brown.

396.—*Timalia pileata*, Horsf.

I shot a single specimen of this bird at Elephant Point in the beginning of January, but did not meet with any more. Its sex is doubtful, the generative organs not being sufficiently developed for determination. It measured in the flesh :—

Length, 5·6 ; expanse, 7·8 ; tail from vent, 2 ; wing, 2·55 : tarsus, .98 ; bill from gape, .78 from nares, .52.

Irides, reddish brown ; bill, black ; legs and feet, dusky black.

452 ter A.—*Ixus Davisoni*, Hume.

I have seen several birds which I believe belong to this species amongst the open tree jungle near Elephant Point. I only obtained a single specimen which was a female, and measured in the flesh :—

Length, 7·75 ; expanse, 11·25 ; tail from vent, 3·35 ; wing, 3·35 ; tarsus, .9 ; bill from gape, .9.

Irides, brownish white ; bill, legs, and feet, dusky black.

456.—*Rubigula flaviventris*, Tickell.

This little bird was extremely abundant in the neighbourhood of Rangoon. It occurs also, though sparingly, at Syriam, but I have not met with it in any portion of the country which lies between Elephant Point and China-Ba-keer. It is very familiar in its habits, and seems to prefer the vicinity of houses or villages. It frequently flies off shore, and perches on the rigging of the ships in harbour, where it will remain for hours, warbling songs with peculiarly sweet twittering notes. From its familiar habits it becomes an easy prey to the native boys of the town, who wantonly kill numbers of them with mud bullets discharged from a bamboo bow. The following is a résumé of the dimensions of six specimens recorded in the flesh :—

Length, 7·25 to 7·6 ; expanse, 10 to 10·5 ; wing, 3·15 to 3·45 ; tail from vent, 3·2 to 3·5 ; tarsus, .59 to .65 ; bill from gape, .72 to .75.

Irides, white, with a greenish yellow tinge ; bill, legs, and feet, dusky brownish black.

457 bis.—*Brachypodius melanocephalus*, Gmel.

This species was tolerably abundant at Syriam, frequenting the taller trees in thin forest jungle. I have also met with it in similar localities at Rangoon. I only obtained two specimens, a male and female, of which the following are the dimensions recorded in the flesh:—

Male.—Length, 7·2; expanse, 10·2; tail from vent, 3·1; wing, 3·35; tarsus, .55; bill from gape, .75.

Female.—Length, 6·8; expanse, 9·75; tail from vent, 2·9; wing, 3·35; tarsus, .55, bill from gape, .75. Bill, deep black; legs and feet, plumbeous.

460.—*Otocompsa emeria*, Shaw.

This species was met with, though very sparingly, throughout the district which lies between Elephant Point and China-Ba-keer. It occurs, however, in abundance at Syriam, where, as a rule, it keeps to the sides of the hills and lower elevations. The following is a résumé of the dimensions of six specimens recorded in the flesh:—

Length, 7·5 to 8·25; expanse, 9·4 to 10; tail from vent, 3·2 to 3·6; wing, 3·05 to 3·3; tarsus, .82 to .85; bill from gape, .82 to .87.

Irides, brown; bill, legs, and feet, black.

461 bis.—*Molpastes intermedius*, Hay.

I have met with this species only in the thin tree jungle near Elephant Point, where, however, it appears to be rare. A male bird shot at the end of February measured in the flesh:—

Length, 8·5; expanse, 11·5; tail from vent, 3·7; wing, 3·8; tarsus, .9; bill from gape, .95.

Irides, dark brown; bill, legs, feet, and claws, black.

467.—*Iora typhia*, Lin.

This little bird was met with in tolerable abundance about Rangoon and Syriam, and less frequently at Elephant Point and China-Ba-keer. It appears to frequent loose shrubby jungle and gardens, as well as the outskirts of forest land. The following are the dimensions of four specimens recorded in the flesh:—

Length, 5·2 to 5·6; expanse 7·6 to 8·2; tail from vent, 1·8 to 2; wing, 2·4 to 2·6; tarsus, .73 to .75; bill from gape, .68 to .78.

Irides, light greyish white; bill, slaty blue, lighter at tip; legs and feet, bluish grey.

469.—*Irene puella*, Lath.

This species occurs sparingly at China-Ba-keer, but is extremely common at Syriam, where, in the early mornings, large flocks of these birds may be found feeding amongst the different fig-trees in the neighbourhood. There is no constant difference in size between the two sexes. Three males and three females measured in the flesh show the following result:—

Length, 9·75 to 10·3; expanse, 14·5 to 15·5; tail from vent, 3·75 to 4·25; wing, 4·8 to 5·2; tarsus, .75 to .85; bill from gape, 1·1 to 1·2.

In one female the irides were deep red, in all the remaining specimens of either sex they were light reddish brown; the bill, legs, feet, and claws, were black.

Of nine specimens that I obtained, none exhibited the brilliant small blue plumage of the adult male. None of these specimens, however, were obtained later than the end of February.

471.—*Oriolus chinensis*, Lin.

This species was generally distributed, but by no means abundant anywhere. It frequents thinly wooded forest jungle, keeping, as a rule, to the tops of the tallest tree. A fine male shot near Elephant Point measured in the flesh:—

Length, 10·5; tail from vent, 3·8; wing, 6·2; tarsus, 1; bill from gape 1·45.

Irides, red; bill, fleshy pink; legs, and feet, dusky slate color; claws, horny brown.

472.—*Oriolus melanocephalus*, Lin.

The black-headed Oriole occurs in abundance throughout the entire district. It frequents alike low tree jungle as well a forest land. A male specimen from Syriam measured in the flesh:—

Length, 9·5; expanse, 15·8; wing, 5·1; tail from vent, 3·4; tarsus, .98; bill from gape, 1·3.

Irides, bright red; bill, brownish white, tipped with pinkish; legs and feet, dark slate color; claws, black.

475.—*Copsychus saularis*, Lin.

The Magpie Robin was met with everywhere in tolerable abundance. I have usually seen it in couples frequenting thickets and hedges. The following are the dimensions of four specimens recorded in the flesh:—

Three males.—Length, 8 to 8·7; expanse, 11·25 to 11·7; wing, 3·8 to 3·85; tail from vent, 3·5 to 3·9; tarsus, 1·15 to 1·2; bill from gape, 1 to 1·2.

One female.—Length, 8; expanse, 11; wing, 3·55; tail from vent, 3·3; tarsus, 1·05; bill from gape, 1·05.

Irides, dark brown; bill, legs, and feet, black.

483.—*Pratincola indica*, *Blyth*.

I have only met with this little bird in the neighbourhood of Elephant Point, where it was very abundant. It was always to be found in the open waste ground, and amongst the paddy-fields, flying from one ear of rice to another, and generally selecting those which were taller than the surrounding ones. It is a very wary little bird, just allowing one to get within range of it, when it would at once fly off, and perch again at a little distance off, upon the dried stalk of some withered herb or tall rice-stem.

The following are the dimensions of four specimens recorded in the flesh :—

Two males.—Length, 5·2 to 5·3 ; expanse, 7·5 to 7·25 ; wing, 2·7 to 2·55 ; tail from vent, 2·05 to 2 ; tarsus, ·8 to ·78 ; bill from gape, ·62 to ·66.

Two females.—Length, 5·2 to 4·8 ; expanse, ·7 to 7·2 ; wing, 2·5 to 2·55 ; tail from vent, 1·85 to 1·8 ; tarsus, ·78 to 8 ; bill from gape, ·7 to ·6.

Irides, dark brown ; bill, legs, and feet, black.

518.—*Arundinax sedon*, *Pallas*.

This species appears to be very uncommon. I have only met with it once in the low scrubby jungle near Elephant Point. The specimen then obtained was a female, and measured in the flesh :—

Length, 7·5 ; expanse, 9·5 ; wing, 3·2 ; tail from vent, 3·45 ; tarsus, ·8 ; bill from gape, 1·1.

Irides, dark brown ; upper mandible, dusky brown ; lower mandible, whitish yellow ; legs and feet, slate color.

544 *quat*.—*Drymoipus extensicaudata*, *Swinhoe*.

This little bird is rare. I have only seen a single specimen which I shot on the 1st of January a few miles from Elephant Point. It was running and hopping about amongst some acanthus bushes in a dried-up swamp, holding its tail erect, and giving utterance to a continuous succession of monotonous notes, probably to attract the attention of its partner. It was a male, and measured in the flesh :—

Length, 5·8 ; expanse, ·6 ; tail from vent, 2·85 ; wing, 1·95 ; tarsus, ·8 ; bill from gape ·65

Irides, light brown ; upper mandible, dusky brown ; lower mandible, pinkish white, tipped with horny ; legs and feet, flesh color ; claws, horny brown.

555.—*Phylloscopus fuscatus*, *Blyth*.

This species did not appear to be very uncommon amongst the copses and thickets in the vicinity of Elephant Point. A male bird shot in that locality measured in the flesh :—

Length, 5·5 ; expanse, 7·2 ; tail from vent, 2·4 ; wing, 2·5 ; tarsus, 9·5 ; bill from gape, ·52. Irides, brown ; upper mandible, dusky brown ; basal half of lower mandible, yellowish white ; terminal half, light brown ; legs, and claws, yellowish brown.

558.—*Phylloscopus lugubris*, *Blyth*.

I only saw a single specimen of this species, which I shot in December near Elephant Point. It was a male, and measured in the flesh :—

Length, 4·9 ; expanse, 6·0 ; tail from vent 2 ; wing 2·5 ; tarsus, ·78 ; bill from gape, ·6.

Irides, brown ; upper mandible, dark brown, tipped with light yellowish ; middle part of lower mandible, light brown, whitish at base and tip ; legs and feet, greenish brown.

565.—*Reguloides superciliosus*, *Gmel*.

I have only met with this species at Syriam and in the vicinity of Elephant Point, at both of which localities it appears to be very rare. Two male specimens measured in the flesh :—

Length, 4 to 4·2 ; expanse, 6·25 to 6·8 ; tail from vent, 1·5 to 1·65 ; wing, 1·12 to 1·12 ; tarsus, 7 to 7 ; bill from gape, 5 to ·49.

Irides, dark brown ; upper mandible, dusky brown ; lower mandible, yellowish white, tipped with brown ; legs and feet, yellowish brown ; claws, brown.

593 *quat*.—*Budytes flava*, *Lin*.

This bird appeared to be numerous about Rangoon and in the neighbourhood of Elephant Point, frequenting the open waste ground and dried-up paddy-fields in those localities. A female shot at Rangoon measured in the flesh :—

Length, 6·9 ; expanse, 9·75 ; tail from vent, 3·2 ; wing, 3·35 ; tarsus, 1 ; bill from gape, ·7

Irides, dark brown ; upper mandible, dusky black ; lower mandible, yellowish white edged and tipped with horny brown ; legs, feet, and claws, black.

595.—*Nemoricola indica*, *Gmel*.

I have seen only a single specimen of this species, which I shot in the thickest part of the dense forest jungle a few miles from China-Ba-keer. It was a male, and gave the following measurements in the flesh :—

Length, 8·75 ; expanse, 9·5 ; tail from vent, 2·8 ; wing, 3 ; tarsus, ·8 ; bill from gape, ·9.

Irides, nearly black ; upper mandible, dusky brown ; lower mandible, fleshy white ; legs and feet, purplish white ; claws, horny white.

596.—*Pipastes maculeatus*, Hodge.

This species was met with sparingly in the thin tree jungle and amongst the isolated clumps of trees in the vicinities of Rangoon and Syriam. A female specimen killed at Rangoon measured in the flesh:—

Length, 6·5; expanse, 10·25; tail from vent, 2·5; wing, 8·8; tarsus, 1·87; bill from gape, 1·68.

Irides, dark brown; upper mandible, dusky brown, paler at margin; lower mandible, light yellowish brown; legs and feet, pale brown; claws, horny brown.

599.—*Corydalla Richardi*, Vieillot.

This species was extremely abundant in the paddy-fields and amongst the marshes and open swamps near Elephant Point and China-Ba-keer. The following are the dimensions of four males recorded in the flesh:—

Length, 7·6 to 7·8; expanse, 11·5 to 12·2; tail from vent, 3 to 3·2; wing, 8·45 to 8·7; tarsus, 1·2 to 1·22; bill from gape, 1·8 to 1·85.

Irides, dark brown; upper mandible, dusky brown; lower mandible, pale brownish white tipped with dusky brown; legs and feet very pale brown; claws, horny brown.

600.—*Corydalla rufula*, Vieillot.

This species was abundant in the cultivated and open waste ground around Rangoon and in the neighbourhood of Elephant Point. A female measured in the flesh:—

Length, 6·2, expanse, 10·25; wing, 8·27; tail from vent, 2·45; tarsus, 1·8; bill from gape, 1·75.

Irides, dark brown; upper mandible, dull brown; lower mandible, dirty whitish tipped with brown; legs and feet, pale brown; claws, horny brown.

645.—*Parus caeruleus*, Tickell.

This species was met with abundantly in the open tidal jungle bordering portions of the coast between Elephant Point and China-Ba-keer, and also in similar localities along the margin of the Rangoon river at Eastern Grove. It is a very active little bird, perpetually moving from one bush or tree to another, and frequenting alike the highest *Sonneratia* trees and the lowest mangroves. I have never observed it at any distance from tidal jungle. The following is a résumé of the dimensions of five males recorded in the flesh:—

Length, 5·5 to 5·75; expanse, 8·25 to 8·75; tail from vent, 2·2 to 2·4; wing, 2·42 to 2·55; tarsus, 1·88 to 2; bill from gape, 1·5 to 1·58. Irides, brown; bill, black; legs and feet, slaty blue; claws, black.

674.—*Dendrocitta rufofusca*, Scop.

I only saw a single specimen of this species, which I shot in the forest jungle near Syriam in the beginning of January. It was a male, and measured in the flesh:—

Length, 16·5; expanse, 18·5; wing, 5·85; tail from vent, 9·75; tarsus, 1·35; bill from gape 1·42.

Irides, brownish red; bill, dusky black; legs and feet, slaty black; claws, black.

678 bis.—*Crypsirina varians*, Loth.

This bird occurred in great abundance in the evergreen forests lying between Elephant Point and China-Ba-keer, as well as in the thin tree jungle near the mouth of the Rangoon river. The following is a résumé of the dimensions recorded in the flesh of six male and two female specimens:—

Length, 12 to 13; expanse, 12·75 to 13·5; tail from vent, 7·5 to 8; wing, 4·45 to 4·6; tarsus, 1 to 1·1; bill from gape, 1 to 1·07.

In most specimens the irides were of a fine pale or grayish blue, but in two males they were dark brown; the eyelids of all were margined with reddish or light brown, and the bill, legs, feet, and claws, were deep coal black.

683 bis.—*Sturnopastor superciliaris*, Blyth.

This species was very common in all open cultivated and waste ground, more especially in the vicinity of villages. It was usually met with in parties of from ten to thirty. There is no appreciable difference in size between the two sexes. The following are the dimensions of six specimens recorded in the flesh:—

Length, 9·2 to 9·5; expanse, 13·5 to 14·5; tail from vent, 2·75 to 3; wing, 4·4 to 4·55; tarsus, 1·15 to 1·25; bill from gape, 1·38 to 1·45.

Irides, yellow; bill, orange-red at base, shading into dirty white towards tip; legs and feet, pale yellowish brown; claws, light brown.

686.—*Acridotheres Fuscus*, Wagler.

This species was even more abundant than the preceding. The birds congregated in crowds round every village, and flocks of thirty or fifty might be seen feeding in almost every dried-up paddy field. The following are the dimensions of six specimens recorded in the flesh:—

Length, 9 to 10; expanse, 14·25 to 15·2; wing, 4·5 to 4·9; tail from vent, 2·9 to 3·2; tarsus, 1·25 to 1·35; bill from gape, 1·05 to 1·22.

Irides, whitish, yellowish white, or pale dull yellow; upper mandible, orange, tipped and margined with horny yellow and black at gape; lower mandible, orange, black at base, and tipped with horny yellow; legs and feet, dull brownish yellow.

688.—*Temenuchus malabaricus*, Gmel.

This species was very abundant, frequenting alike forest jungle, open country, hedges, and thickets. I have frequently seen these birds in the forests clinging like tit-mice to the trunks and branches of trees, and apparently searching for insects. They are usually gregarious, consorting in parties of five to fifteen.

The following are the dimensions of four males and two females recorded in the flesh:—

Length, 7·2 to 7·8; expanse, 12 to 12·75; wing, 8·75 to 9·05; tail from vent, 2·5 to 2·8; tarsus, 8·5 to 9·5; bill from gape, ·9 to 1·05.

Irides, dull white, greyish or pale yellowish white; bill, bright apple green, dusky green at base, bright yellow towards point, tipped and margined with pale yellow; legs and feet, pale brown or yellowish brown.

688 bis.—*Temenuchus burmanicus*, Jord.

This appears to be a rare species. I have only seen a single specimen, which I shot in November in the open forest jungle near Rangoon. It was a male, and measured in the flesh:—

Length, 9·4; expanse, 14·5; tail from vent, 3·2; wing, 4·52; tarsus, 1·3; bill from gape, 1·22.

Irides, light yellow; bill, bright orange red, tipped with horny yellow, and dusky black at base, naked lores, dull brown; legs and feet, yellowish brown.

688 quart.—*Temenuchus membriciolus*, Jord.

This species appears to be just as common as *Malabaricus* from which it does not appear to differ in habits. I have generally killed both species together in the same flock. The following is a résumé of the dimensions of six specimens recorded in the flesh:—

Length, 7·2 to 7·7; expanse, 11·7 to 12·5; tail from vent, 2·4 to 2·9; wing, 8·7 to 9·5; tarsus, ·8 to ·9; bill from gape, ·9 to 1·05.

Irides, pale yellowish white; bill, apple green, duller at base, and terminal portion bright yellow, tipped and margined with lighter yellow; legs and feet, pale brown or yellowish brown.

691.—*Saragossa Spilogaster*, Vigors.

I shot a pair of these birds on the 1st January in the low scrubby jungle near Elephant Point. They are the only specimens which I have seen, and appear to be very rare throughout the district. The male measured in the flesh:—

Length, 7·85; expanse, 13·5; tail from vent, 2·55; wing, 4·25; tarsus, ·88; bill from gape, ·98.

Irides, dull white; bill, dusky black, reddish black at base of lower mandible; upper and lower mandibles margined with pale yellow; legs, feet, and claws, black.

The female measured in the flesh:—

Length, 7·75; expanse, 13; tail from vent, 2·5; wing, 4·15; tarsus, ·9; bill from gape, 1.

Irides, white; bill, black, dusky yellow at gape; legs, feet, and claws, black.

693.—*Eulabes javanensis*, Osbeck.

This species occurs sparingly in the evergreen forests about Syriam and China-Ba-keer. Two males measured in the flesh:—

Length, 10·5 to 11; expanse, 20 to 19·25; wing, 6·5 to 6·15; tail from vent, 3·1 to 3·4; tarsus, 1·35 to 1·32, bill from gape, 1·5 to 1·42.

Irides, dark brown; nude lores, orbital skin, and lappets, yellow; bill, deep orange red, bright shading into bright yellow towards tip; legs, feet, and claws, dirty yellow.

693 sex.—*Ampeliceps coronatus*, Blyth.

This species appears to be very uncommon throughout the entire district. I have only met with it once in the thick and almost impenetrable underwood of the forest jungle near China-Ba-keer. It then formed one of a party of eight or ten of the same species, who were chirping and chattering and chasing each other amongst the dense thickets in that locality. The following are the dimensions of a male specimen recorded in the flesh:—

Length, 8·7; expanse, 16·2; tail from vent, 2·5; wing, 5·05; tarsus, 1; bill from gape, 1·05.

Irides, dark brown; bill, dull greenish tipped and margined with yellow; legs and feet, bright ochreous yellow; claws, dark brown.

704 bis.—*Estrelda burmanica*, Hume.

This little bird appears to be very rare throughout the entire district. I have only once met with a single pair, a few miles from Elephant Point, amongst the tall grass ridges, which form the boundaries between the paddy-fields. It always rested upon some tall grass panicle, feeding apparently upon the seed, and, when disturbed, would fly across the paddy-field to

876.—*Terekia cinerea*, *Gmel.*

The Avoset Sand-piper was by no means abundant. I only saw two or three specimens feeding along with Stints and Sand-plovers on the mud flats near Elephant Point. A male bird shot in January measured in the flesh :—

Length, 9·2; expanse, 16·75; tail from vent, 2·2; wing, 5·25; tarsus, 1·15; bill from gape, 2·25.

Irides, dark brown; basal third of bill orange dusky, thence shading into dusky black for the remainder of its length; legs and feet, bright yellow; claws, black.

877.—*Numenius lineatus*, *Cuv.*

This species was extremely abundant all along the coast from Elephant Point to China-Ba-keer, as well as along the eastern shore of the mouth of the Rangoon river. They were nearly always met with in parties varying from four or five to forty or fifty. They were always excessively wary and difficult to approach. The male bird is smaller than the female, more particularly in the length of bill. A male bird, shot near the Eastern Grove Light-house in February, measured in the flesh—

Length, 21·5; expanse, 38; tail from vent, 4·5; wing, 11·1; tarsus 8·1; bill from gape, 5·2.

A female shot in January at Deserter's Creek, measured in the flesh :—

Length, 24·3; expanse, 40·75; tail from vent, 4·5; wing, 11·2; tarsus, 8·6; bill from gape, 7·2.

Irides, dark brown; upper mandible, dusky black; lower mandible, dirty pinky; white, at base; remainder, dusky black; legs and feet, livid slate grey.

878.—*Numenius phaeopus*, *Linn.*

The Whimbrel, although abundant, did not occur in such large numbers as *Lineatus*. It was for the most part solitary, but I have also met with in small parties of five or six. A male bird, shot on the banks near the mouth of the Rangoon river, measured in the flesh :—

Length, 17·5; expanse, 28; tail from vent, 3·8; wing, 9·2; tarsus, 2·4; bill from gape, 3·8.

Irides, dark brown; upper mandible, dusky black; basal two-thirds of lower mandible, fleshy white, terminal third, dusky black; legs and feet, ashy grey.

881 bis.—*Tringa crassirostris*, *Tem. et Schleg.*

This species was apparently rare. I only obtained a single specimen, which I shot on the sands near China-Ba-keer.

They feed in company with other Stints of smaller species, amongst which they are conspicuous by their size. The specimen shot was a male, and measured in the flesh :—

Length, 11·15; expanse, 23; tail from vent, 2·6; wing, 6·9; tarsus, 1·38; bill from gape, 1·9.

Irides, dark brown; bill, dusky black, paler at base of lower mandible; legs and feet, greenish dusky.

882.—*Tringa subarquata*, *Gmel.*

This was by no means a common species about the mouth of the Rangoon river, where alone I met with it. It was most abundant at low water, where it might be seen hunting for food in the soft mud close to the water's edge. At high water it was found amongst the freshwater jheels in the neighbourhood of Elephant Point. The following is a résumé of the dimensions of several species recorded in the flesh :—

Length, 8 to 9·2; expanse, 14·2 to 16·25; tail from vent, 1·8 to 2·2; wing, 4·9 to 5·25; tarsus, 1·18 to 1·25; bill from gape, 1·45 to 1·6.

Irides, dark brown; bill, legs, and feet, dusky black.

884.—*Tringa minuta*, *Leisler.*

This little Stint was extremely abundant all along the sea-coast lying between Elephant Point and China-Ba-keer. It seemed, as a rule, to prefer the more sandy part of the shore, and did not appear to frequent the mud-banks, for even at low water it was always to be found feeding on the sand which was bordering the margin of the mud. The following is the result of the measurements of numerous specimens recorded in the flesh :—

Length, 5·75 to 6·5; expanse, 11·75 to 12·5; tail from vent, 1·8 to 2·1; wing, 3·75 to 4; tarsus, .75 to .8; bill from gape, .75 to .85.

Irides, dark brown; bill, legs, and feet, black.

With regard to the variations in the size of the wing in birds of this species from different localities, Mr. Hume says in "STRAY FEATHERS," Vol. I., p. 243 :—"Amongst all my Indian killed specimens, male and female, in winter and in summer plumage, only one has a wing above 3·9; in the vast majority the wings are between 3·7 and 3·8; and in a few specimens the wings range between 3·6 and 3·7, and again in a very few between 3·8 and 3·9." Now out of ten specimens shot by me in Burma, one only is as small as 3·75; two measure 3·8; two, 3·9; two, 3·92; and the remaining three reach a length of 4. Thus it would appear that the Burmese specimens attain a considerably larger average length of wing than those killed in India.

886.—*Tringa platyrhyncha*, *Temm.*

This species was excessively common throughout the entire district lying between the mouth of the Rangoon river and China-Ba-keer. It was also common along the margins of all

the creeks and nullahs in the vicinity, extending up the Rangoon river as far as the junction of the latter with its Pegu tributary. Four males measured in the flesh show the following result:—

Length, 6·5 to 7; expanse, 12·3 to 13·4; tail from vent, 1·5 to 1·9; wing, 4 to 4·25; tarsus, .85 to .95; bill from gape, 1·25 to 1·4.

Irides, dark brown; bill, legs, and feet, dusky black.

887.—*Eurynorhynchus pygmaeus*, Lin.

The neighbourhood of Elephant Point, at the mouth of the Rangoon river, has not as yet been recorded as a locality from whence this remarkable species has been obtained. It seems to be of rare occurrence in that district, for although several days were spent by me in careful and systematic search for it, yet I was never able to see or to obtain more than a single specimen. The specimen referred to was one of a score or more of other birds, belonging to the smaller species of *Egialitis* and *Tringa*, which were all killed at one shot as they were feeding together in a common flock of many hundreds on the sand-banks fringing high water mark. It is a female in winter plumage, and was shot on the 1st of December. The following dimensions were recorded by me in the flesh:—

Length, 6·2; expanse, 12·15; tail from vent, 1·7; wing, 3·92; tarsus, 8·3; bill from gape, .98; from forehead to tip, 1·05; from behind nares to tip, .83; greatest width of upper mandible, .41; greatest width of lower mandible, .38.

The irides are of a deep dark brown; bill, legs, feet and claws, black; mid-toes, .76 inches in length.

888.—*Calidris arenaria*, Temm.

This bird was somewhat rare. I have only met with it at Elephant Point, where it feeds on the sands along with Sand-plovers and Stints. The following are the dimensions of a male bird recorded in the flesh:—

Length, 7·75; expanse, 15; tail from vent, 2·2; wing, 4·9; tarsus, 1; bill from gape, 1·15.

Irides, dark brown; bill, legs, feet, and claws, black.

891.—*Actitis glareola*, Gmel.

The spotted Sand-piper was tolerably abundant on the sand-banks between Elephant Point and China-Ba-keer. A male specimen recorded in the flesh measured:—

Length, 9·15; expanse, 14·75; tail from vent, 2·1; wing, 4·8; tarsus, 1·5; bill from gape, 1·45.

A female measured in the flesh:—

Length, 8·3; expanse, 14·5; tail from vent, 2; wing, 4·85; tarsus, 1·55; bill from gape, 1·3.

In both the irides were dark brown; bill, dusky black, except near base, where it was greenish; legs and feet, slate green.

893.—*Tringoides hypoleucus*, Lin.

The common Sand-piper was not very abundant anywhere. It was usually met with in small parties in cultivated land and ploughed fields and on the margins of tanks and jheels. The following is a résumé of the dimensions of several specimens recorded in the flesh:—

Length, 7·6 to 8; expanse, 13 to 13·8; tail from vent, 2·2 to 2·45; wing, 4·2 to 4·3; tarsus, .92 to 1; bill from gape, 1·05 to 1·2.

Irides, brown; legs and feet, greenish brown.

894.—*Totanus canescens*, Gmel.

This species was very abundant in all the jheels and along the margins of the mud flats in the vicinity of Elephant Point. They were usually solitary, but were frequently met with in parties of three or four. The measurements of several male specimens recorded in the flesh show the following result:—

Length, 13·2 to 14·25; expanse, 22 to 23·5; tail from vent, 3·2 to 3·5; wing, 7·4 to 7·8; tarsus, 1·5 to 2·62; bill from gape, 2·3 to 2·4.

The females are somewhat smaller. A specimen of this sex measured in the flesh:—

Length, 13·25; expanse, 21·6; tail from vent, 3·1; wing, 7·15; tarsus, 2·25; bill from gape, 2·32.

In all the irides were dark brown; bill, dusky black; legs and feet, slate green; claws, black; length of mid-toe and claw, 1·5.

894 bis.—*Totanus Haughtoni*, Nobis Sp. Nov.

Amongst the numerous varieties of shore birds killed on the sand and mud flats between Elephant Point and China-Ba-keer, is one, of which I have secured two specimens, which appear to be new to ornithology.

I propose to describe this presumably new species under the above name, dedicating it to my valued friend, the Rev. Professor Haughton, of Trinity College, Dublin, whose labours have done so much to enlarge the field of Natural History research.

The species appears to be decidedly rare throughout the entire district. I have never seen more than the two specimens obtained, both of which were shot in December at China-Ba-keer, as they were feeding on the extensive sand-banks in that locality, in company with a large flock

of Sand plovers. It bears a striking general resemblance to specimens of *Totanus canescens*, Gmelin, from which, however, as well as from all other Indian species belonging to the same sub-family, it differs conspicuously, in the comparatively much longer, broader, and more massive bill, in the much shorter length of tarsus, as well as in the unusual fact of the three anterior toes being united to each other by a membrane.

The following are the dimensions and a description of the bird founded upon the measurements recorded in the flesh of the two specimens obtained at China-Ba-keer :—

	Length.	Expanse.	Wing.	Tail from vent.	Tarsus.	Bill from gape.	Bill at front.	Bare portion of Tibia.	Mid-toe and Claw.	Hind-toe and Claw.
♂	18·2	23·2	7·3	3·0	1·85	2·5	2·1	0·95	1·5	0·52
♀	12·9	22·3	7·0	3·0	1·65	2·2	1·93	0·86	1·4	0·5

In both specimens the irides are dark brown; bill, horny yellow near the base, fading into dusky for the terminal half, which is tipped with black; legs and feet, dull ochreous yellow; claws, black.

Feathers of crown, occiput, back of head, scapulars, and upper back, of a uniform cinereous grey, each with a dark central longitudinal stripe, which is darker and more pronounced in the interscapular region. Lower back, rump, and upper tail coverts, white, the feathers of these parts having near their extremities one or two ill-defined, dusky blotches, which on the upper tail coverts become developed into a pair of more or less clearly defined V-shaped transverse bars. Forehead and pre-orbital region of a much lighter grey, and more mixed with white than the other portions of the head. The throat and front of the neck, the entire breast and abdomen, the under tail coverts, as well as the axillary plumes and under-wing coverts are pure white. On the sides of the neck the feathers are also white, but each has here a dark narrow shaft stripe, thus giving a lineo-punctate appearance to that portion of the bird. The tail, which is short and nearly even, is greyish white, margined and tipped with pure white; the two central feathers alone are brownish, and more narrowly margined with white than the others. The wings are long and pointed; the primary quills and their coverts are of a rich hair brown, faintly margined with lighter brown on their outer webs. Secondary quills with their coverts, dusky brown, each with a well-defined white margin and tip, which, however, is much narrower on the quills, but is broader and clearer on the coverts. The tertaries are long and plume-like, of an ashy brown color, the shafts being of a much darker color than the webs. Along the entire length of the radius and angle of the shoulder, there is a well-defined line of demarcation between the dark hair brown of the upper, and the pure white of the under surface. The shaft of the first quill feather is pure white, all the others being of a more or less pronounced brown. First quill longest, second about a quarter of an inch shorter. The bill is long, broad, and massive, slightly recurved for its terminal third, and with both mandibles grooved, one for a little more than half its length. The end of the upper mandible is slightly expanded, and has its points bent down over the lower. The nostrils are linear and sub-basal, a little over quarter of an inch in length, and nearly that distance from the most anterior feathered portion.

The tarsi are short and somewhat slender. The toes also are slender, the three anterior being united to each other by a membrane, which, extending on either side of the middle toe from the distal extremity of its proximal phalanx, reaches well down to a similar point in the inner, and nearly to the distal extremity of the second proximal phalanx in the outer.

895.—*Totanus stagnatilis*, Beckst.

This species, though not scarce, was by no means abundant. It was more frequently met with on the margins of the tidal nullahs and creeks, than on the extensive mud flats at the mouth of the river. Specimens measure in the flesh :—

Length, 10·2 to 10·7; expanse, 15·5 to 16·2; tail from vent, 2·6 to 2·85; wing, 5·2 to 5·3; tarsus, 2 to 2·03; bill from gape, 1·7 to 1·75.

Irides, dark brown; bill, dusky greenish black; legs and feet, greenish plumbeous.

897.—*Totanus calidris*, Lin.

This species was extremely abundant, occurring in large quantities both on the shore between Elephant Point and China-Ba-keer, and along the margins of the numerous nullahs and creeks in the vicinity. They generally associate in large flocks, which do not appear to hunt for food in company with other birds of different species. The combined effect produced by the red legs of a large flock of these birds is very striking, having the appearance of a large red patch moving about on the sands. In this way they may be recognized with facility from a considerable distance. Male birds measured in the flesh :—

Length, 10·35 to 11·29; expanse, 19·4 to 19·8; tail from vent, 2·5 to 2·8; wing, 6·8 to 6·3; tarsus, 2 to 2·1; bill from gape, 2·05 to 2·15. The females are somewhat smaller, and give the following measurements in the flesh :—

Length, 10·75 to 11·25; expanse, 18·75 to 19·5; tail from vent, 2·5 to 2·7; wing, 5·8 to 6·1; tarsus, 2 to 2·1; bill from gape, 1·9 to 2.

In both male and female the irides are dark brown; the bill, dusky red for basal third, from thence to tip dusky black; legs and feet, orange red.

900.—*Metopodius indicus*, Lath.

I only met with this bird in the jheels and tanks which were overgrown with aquatic plants and grasses. In these localities it was extremely abundant, lying so close amongst the vegetation, that frequently it would not rise until I had got so near as almost to be able to touch it. A fine male bird in the full black plumage of the adult was shot by me in one of these jheels near Elephant Point on the 31st December. It measured in the flesh:—

Length, 11·5; expanse, 20·5; tail from vent, 1·75; wing, 6·35; tarsus 2·5; bill from gape, 1·4; hind toe and claw, 3·4.

Irides, dark brown; the shield and cere extending down as far as the nares, greenish olive; bill, greenish, shading into a reddish white at base and gape; legs and feet, dull dusky green.

Another male bird in what Mr. Oates considers to be the plumage of the young bird in its second spring was shot near the same locality on the 10th February, and the following particulars were recorded in the flesh:—

Length, 11·45; extent, 2·22; tail from vent, 1·8; wing, 6·7; tarsus, 2·45; bill from gape, 1·4; hind toe and claw, 3·1.

This specimen is well advanced in the transition stage from the light to the dark plumage. The rufous of the head has been almost entirely replaced by deep metallic green concolorous with the back of the neck, and amongst the buff feathers on the side of the neck numerous dark green feathers have begun to make their appearance, but no change whatever has as yet taken place in the under parts.

It may be worth while remarking that the dimensions recorded of this specimen very considerably exceed those given by Mr. Oates for young males measured by him, and in some particulars are greater even than the dimensions of the adult male in black plumage, as recorded by that gentleman.

913.—*Hypotænidia striata*, Lin.

I only saw this species in marshy ground in the vicinity of Syriam, where it was decidedly scarce. A male specimen, shot on the 16th February, measured in the flesh:—

Length, 10·3; expanse, 16·2; tail from vent 1·8; wing, 4·75; tarsus, 1·47; bill from gape, 1·7.

The irides were of a light yellowish brown; upper mandible, dusky brown, except at the gape, where it was orange; lower mandible, orange, shading into dusky brown for its terminal third; legs and feet, plumbeous green.

929.—*Bubulcus coromandus*, Bodda.

The Cattle Egret was met with in great abundance throughout the entire district. It frequented the mangrove swamps and tidal jungle lying between Elephant Point and China-Ba-keer, perching, as a rule, upon the low mangroves and other bushes in those localities. It was also very abundant at a considerable distance from the shore, probably attracted by the herds of buffaloes, a large number of which are kept for agricultural purposes by almost every Burman in that region, and which, when let out to graze, were almost invariably accompanied by a considerable party of these birds. The following is a résumé of the dimensions of numerous specimens recorded in the flesh:—

Length, 19·2 to 20·2; expanse, 32 to 34·5; tail from vent, 3·2 to 3·6; wing, 9·8 to 9·9; tarsus, 3·3 to 3·7; bill from gape, 3·4 to 3·45; mid-toe and claw, 3·1 to 3·15.

Irides, yellowish white; orbital skin, pale yellowish green; bill, yellow with a greenish tinge at the base; legs and feet, black; mid-toe claw, pectinated on inner margin.

930.—*Ardeola Grayii*, Sykes.

This species was extremely common and abundant in every nullah and creek near the mouth of the Rangoon river as well as all along the shore intervening between Elephant Point and China-Ba-keer. They frequented the mud flats when the tide was low, and generally at high water resorted to the mangroves bordering the shore or neighbouring nullahs. Male birds appear to be somewhat larger than the females. A fine specimen measured in the flesh:—

Length, 15·2; expanse, 25·75; tail from vent, 2·9; wing, 8·65; tarsus, 2·3; bill from gape, 3·2.

Females.—Length, 14·25 to 14·6; expanse, 23·2 to 23·8; tail from vent, 2·55 to 2·65; wing, 7·55 to 7·6; tarsus, 1·9 to 2·2; bill from gape, 3·1 to 3·15.

937.—*Nycticorax nycticorax*, Lin.

The Night Heron is undoubtedly rare.

I only met with a single specimen, which I shot in the upper branches of a large tree overhanging a nullah near Elephant Point. It was a male, and measured in the flesh:—

Length, 23; expanse, 40·6; tail from vent, 4; wing, 11·5; tarsus, 3; bill from gape, 4·1.

The irides were rich crimson; upper mandible, dusky black, irregularly blotched near the base with greenish; basal half of lower mandible, greenish horny, terminal half dusky black; legs and feet, light ochrish yellow; claws, horny black.

980.—*Larus brunneicephalus*, *Jerd.*

This gull, which was the only species met with, swarmed at the mouth of the Rangoon river, and about China-Ba-keer, and was also present in abundance throughout the intervening district. Specimens measure in the flesh :—

Length, 17 to 18·2; expanse, 38·75 to 44·25; tail from vent, 4·8 to 5·2; wing, 12·4 to 13; tarsus, 1·75 to 2; bill from gape, 2·15 to 2·25.

Irides, white; bill, orange red, tipped and margined with dusky; legs and feet, red.

983.—*Sterna nilotica*, *V. Hasseltq.*

This species was met with in abundance along the shore lying between China-Ba-keer and Elephant Point. It always preferred hunting for its prey at the water's edge, so that it was only possible to secure specimens at high water, in consequence of the impossibility of crossing the broad mud flats, which at low water intervene between the beach and the margin of the water. Specimens shot measure in the flesh :—

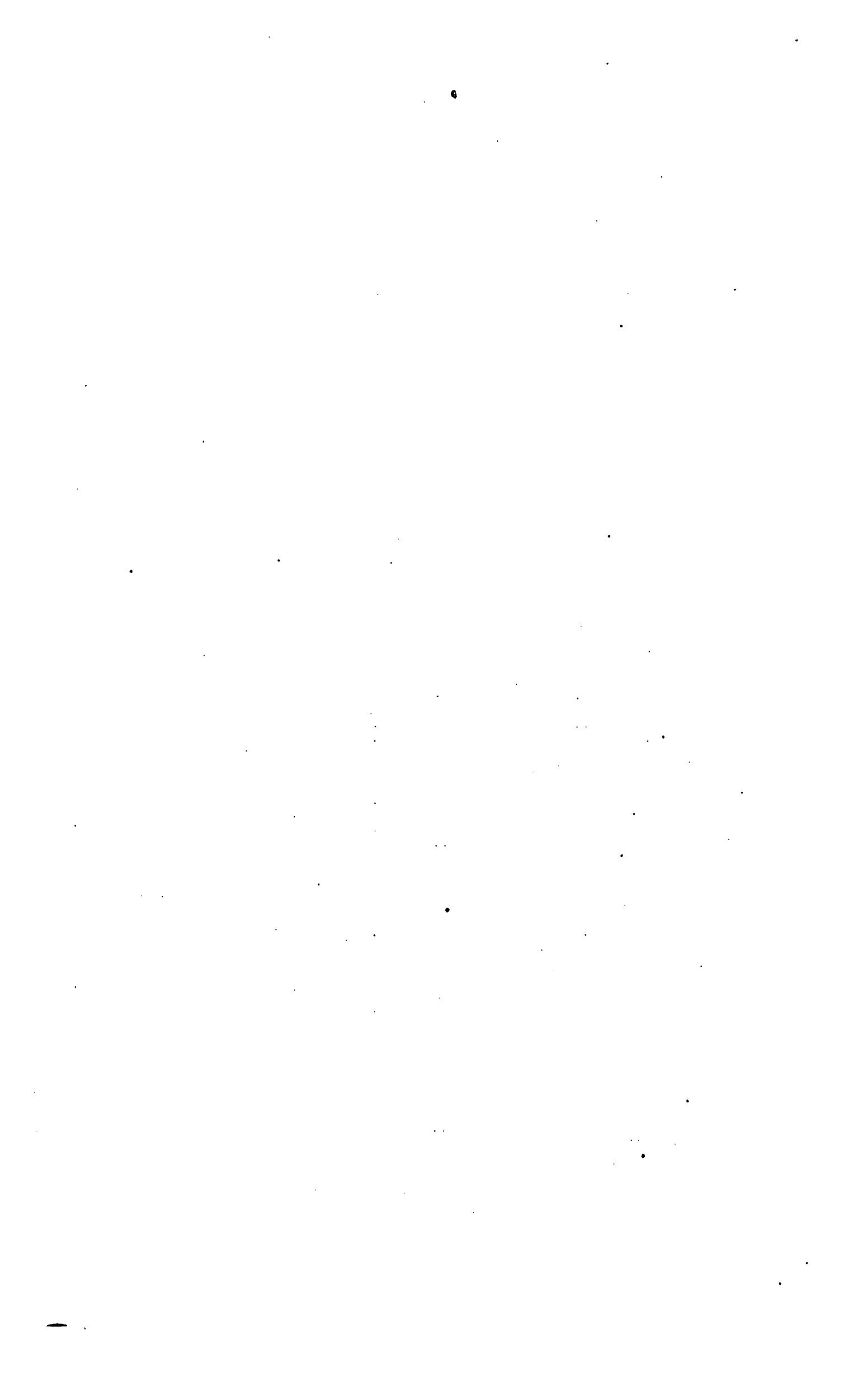
Length, 12·5 to 14·25; expanse, 34·25 to 39·75; tail from vent, 4 to 5·5; wing, 11·25 to 12·2; tarsus, 1·2 to 1·4; bill from gape, 1·9 to 2·4.

L.

Statement shewing the cost of the Marine Survey Department from the 1st April 1876
to the 31st March 1877.

PARTICULARS.	Amount of each item.	Total of each heading.
	Rs. A. P.	Rs. A. P.
OFFICE OF SUPERINTENDENT OF MARINE SURVEYS.		
Superintendent of Marine Surveys ...	21,600 0 0	
Superintendent, Drawing Branch ...	8,558 1 1	
Office of Superintendent of Marine Surveys ...	7,272 15 6	
		37,431 0 7
CONTINGENT CHARGES.		
Contingencies ...	2,857 13 10	
Travelling and halting expenses for inspection journeys ...	1,862 11 0	
		4,720 8 10
SCIENTIFIC OFFICERS.		
Scientific Officers ...	41,261 9 9	
Allowance to one Surveyor as Draftsman ...	600 0 0	
Medical Officer and Naturalist ...	4,800 0 0	
House rent and conveyance allowance to Surveyors ...	4,441 5 8	
Travelling expenses of Surveyors to and from the surveying grounds ...	1,043 8 0	
Travelling expenses of two Surveyors from Portsmouth to Calcutta ...	679 0 0	
Halting allowance of Surveyors whilst absent from Calcutta on Surveying duties ...	1,370 0 0	
		54,195 7 5
EXECUTIVE OFFICERS.		
Executive Officers ...	1,393 8 10	
		1,393 8 10
I. G. STEAMER CLYDE.		
Wages of crew ...	20,621 0 7	
European and Native provisioners ...	1,603 5 1	
Contingencies ...	1,378 11 9	
Hospital charges ...	14 12 0	
Provisions ...	2,466 0 11	
Stores ...	3,711 0 3	
Coal ...	2,883 0 0	
Repairs ...	1,675 0 0	
		34,352 14 7
I. G. SCHOONER CONSTANCE.		
Wages of crew ...	3,967 12 0	
European and Native provisioners ...	603 4 0	
Contingencies ...	635 11 3	
Hospital charges ...	8 0 0	
Repairs ...	155 0 0	
Travelling expenses of the Assistant Apothecary of the Constance to Bombay on transfer ...	66 10 9	
		5,436 6 0
STEAM CUTTERS.		
Contingencies ...	9 0 0	
Repairs ...	685 0 0	
		694 0 0
SURVEY OF MADRAS ROADSTRADE.		
Wages of leadsmen ...	94 8 0	
Native provisioners ...	72 0 0	
Contingencies ...	143 4 0	
Travelling expenses of leadsmen from Calcutta to Madras and back ...	296 0 0	
		605 12 0
SURVEY OF CHITTAGONG (KORNAFULI) RIVER.		
Wages of crew and a Sub-Assistant Surveyor ...	861 9 2	
European and Native provisioners ...	73 6 8	
Contingencies ...	197 8 0	
Stores for Steam Cutter ...	456 14 0	
Travelling expenses of crew from Chittagong to Calcutta ...	65 0 0	
		1,654 5 10
GRAND TOTAL	.....	1,40,484 0 1

A. D. TAYLOR,
Superintendent Marine Survey of India.



No. 182.

Extract from the Proceedings of the Government of India, in the Department of Revenue, Agriculture and Commerce,—dated Simla, the 5th April 1878.

MARINE SURVEYS.

READ—

Report on the operations of the Marine Survey Department for the year 1876-77, submitted by the Superintendent with his letter No. 2, dated the 5th ultimo.

O B S E R V A T I O N S.

The surveying work of the year was confined to the Burma Coast, Chittagong, and Madras. On the first named the *Clyde*, under Lieutenant Jarrad, leaving Calcutta on the 14th November 1876, surveyed the Moulmein River and its approaches in detail, corrected the position of Double Island on the Admiralty chart, ascertained the meridian distance between Diamond Island and Akyab, and endeavoured to continue the detail survey of Akyab, which in 1875-76 it had been necessary to relinquish in consequence of a severe outbreak of cholera. The same cause, however, again interfered with the work, and after completing the main triangulation and a portion of the coast of Akyab, the *Clyde* left for the Western Borongo and Kyouk Phyoo, where the coast and foreshore shewn on the Admiralty charts were corrected. After the completion of the season's work, the *Clyde* was returned to the Marine Department.

2. The examination of the mouth of the Karnafuli, or Chittagong River, was conducted by Lieutenant Hammond, who left Calcutta with a steam cutter for the purpose on the 17th December 1876; the party returned on the 25th January without completing the work, the ravages of the cyclone and the epidemic of cholera which followed it having made the place extremely unhealthy; although insufficient to afford a complete survey of the port, the examination sufficed to ascertain the points necessary to enable an opinion to be formed in regard to the removal of the Norman's Point lights, which was the immediate object of the survey.

3. The survey of Madras was undertaken in connection with the harbour works. The Roadstead was twice visited,—once by Lieutenant Jarrad, who was engaged there from the 9th September to the 29th October 1876, and again by Lieutenant Hammond, who carried on his survey from the 10th February 1877 till (apparently) the middle of April; the result was a survey of about $4\frac{3}{4}$ miles of the coast North and South of the screw-pile pier. Both officers were much delayed in their operations, partly by the want of an efficient tide-gauge, and partly by the unsatisfactory state of the steam cutter in which the greater part of the survey was made.

4. In addition to these regular surveys carried on by the executive staff, Commander Taylor himself contributed to the correction and completion of the charts of several portions of the coast by means of information gathered during his tours. During a tour undertaken down the Burma coast in March, April and May 1876, he was able to correct the chart of Tavoy River; in July 1876 he visited False Point, and submitted valuable reports on that harbour; and in March 1877 he made a careful examination of the previously unsurveyed harbour of Goa and Marmagao, besides examining the port of Carwar.

5. The Drawing Branch under Mr. Carrington has done much good work during the year; the original survey of Chittagong River, and copies of those of the Madras Roadstead and False Point, have been prepared for the Hydrographer to the Admiralty; photo-zincographed copies of charts of the Madras Roadstead, False Point, Tavoy River, Goa and Marmagao roadsteads, and lithographed copies of a chart of False Point anchorage, have been issued to the public; of extra-Indian surveys, photo-zincographed copies of charts of Puket, Junkseylon, and Kopah Inlet have been published; and photo-zincographed

copies of charts on a small scale of several portions of the Madras and Malabar coasts, compiled from various sources, have been issued for the purposes of local trade. Much miscellaneous work has also been done in this Branch.

6. The issue of "Notices to Mariners" has continued with punctuality, and the list of Indian lights has been carefully kept up to date. The annual Return of Wrecks and Casualties, which forms another branch of the work of the Department, has been taken systematically in hand, and this important return will shortly, it is to be hoped, be issued in a much more correct and trustworthy form than any in which it has as yet appeared.

7. The question of the maintenance of a chart dépôt, and the supply of charts to the public by the Marine Survey Department, still forms the subject of correspondence between the Government of India and the Secretary of State.

8. The cost of the Department during the year was Rs. 1,40,484.

ORDERED, that copy of this Resolution be forwarded to the Superintendent of Marine Surveys for information.



1878

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE,
AGRICULTURE AND COMMERCE.

MARINE SURVEYS.

To

R E S O L U T I O N .

No. 182.

Dated Simla, the 5th April 1878.

S U B J E C T .

Review of the Report on the operations of the
Marine Survey Department for the year 1876-77.

